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ANNALS OF SURGERY

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ORIGINAL MEMOIRS.

THE BLOOD IN SURGERY.*

A HISTORICAL AND CRITICAL STUDY.

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THERE are three commonly accepted methods of studying a problem—whether that problem be a political propaganda, a question of social science, a biological puzzle, a piece of medical research, or an undertaking in practical mechanics. These three methods we call severally, (1) the inductive method of the scientist; (2) the practical method of the technical craftsman, and (3) the literary method of the student. Take, for example, the steam-engine as a problem to be investigated: the *scientist*—the properly trained physicist, studies the force-production of coal and the expansive power of steam acting upon a complicated mechanism of steel for the accomplishment of work; on the other hand, the *technical craftsman*—the trained mechanic, is concerned with the construction of the apparatus, the firing of its boilers, and the setting it in motion; while by the literary method the *student* of steam power as applied to the development of civilization looks to remote causes, and to effects immediate and remote. The last named—the student—reviews the observations and hypotheses of the ancients; the vagaries of the mediæval alchemists; the crude, practical endeavors of the early moderns, and so he comes down to the accomplishments of Watts and the Stevensons, and grasps the significance of those prophets of modern industry; while he summarizes and assigns to their proper perspectives the vast individual factors in the complex of modern life as affected by steam power; foreseeing perhaps —or attempting to foresee—the bearing of it all upon the mechanic arts of the future and their influence upon the history of the race.

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These three methods of study are applicable as well to medical problems, and the three classes of workmen find their labor in appropriate fields: The scientist investigates in his laboratory questions of biology—of physiology, anatomy and chemistry as concerned with the problem in hand. The technical craftsman, or practical clinician, as we call him, carries to the sick-bed the findings of the laboratory, and demonstrates their significance in the vital field of therapeutics. And finally, by the literary method, the student of medicine as a whole—of medicine in its wide bearing upon human happiness and progress, adds his quota also to the elucidation of the problem. It is his function to trace out and to collaborate the story of men and of measures: on the one hand to show, in the broad sense, the immense influence which the progress of medicine has had upon the progress of civilization, medicine's present significance and its probable future; and, on the other hand, and in a narrower sense perhaps, to trace the growth of our knowledge of special diseases. In this way best, I believe, may one reach a proper conception of the attainments of our predecessors; of the place at which we are arrived; of the value of special research; of the futility of certain lines of endeavor; and of the rate and probable outcome of to-day's progress.

This third method of studying problems in medicine is a method deserving more consideration than we have always given it. We are prone to consign it to the dust-bin of medical history—of history in the nonphilosophic sense; but the study of medical history, properly pursued, means something more than the resurrecting of remote happenings—the dry bones of an emotionless past. Past and present are interwoven closely in such studies. The most successful clinician or investigator of to-day will be the first to appreciate the bearing of past facts upon present problems; while the intelligent recorder of past events must be versed and facile in the conduct of modern research and in the interpretation of clinical facts.

To be specific, in the following paper I propose—somewhat haltingly, I fear—to consider the subject of the Blood in Surgery from our third point of view—the point of view of the student of literature. In these days most of us who investigate this matter are busied, some with laboratory studies on the effects of hemorrhage and on the results of transfusion, and some in applying directly to patients the measures proved useful by laboratory experimentation. Shall not we here properly and timely, therefore, review the development of studies in the blood as we see them to-day?

The problem of the blood in surgery presents certain features, which I shall recall to you; and I shall discuss these features from the historical standpoint as well as from the critical standpoint of the present. We shall consider the *circulation, hemorrhage,* and *transfusion,* while various cognate matters incidentally must be developed.

Let us turn first to a discussion of knowledge of the circulation, as it became clear gradually to physiologists. No subject in the history of medicine is more vital or illuminating. In a former writing, on Aneurism, I said some little on this matter, but in that writing I was concerned with a field more narrow than that we are now considering.

To the ancients the problem of the circulation was truly a problem, though time and again some prophet arose who thought he had solved it. It is interesting to recall the fact that the great Hippocrates early in the Third Century B. C.

described the heart as a great muscular engine, even though it was not clear to him what function the heart served. Yet. five hundred years later, Galen taught his Roman students that the heart is *not* a muscle. Galen led physiological thought for fifteen hundred years, with the result that his misconceptions regarding the heart turned away to false conclusions hundreds of his successors. This fact is especially surprising when we remember that Aristotle, the great natural philosopher of Greece, soon after Hippocrates, about 340 B. C., had stated that the heart is the central organ of the circulation and is the mover of the blood.

In the light of history we cannot but marvel at the centuries of ignorance and misconception which followed the two assertions of Hippocrates and of Aristotle—their assertions that the heart is a muscular organ, and that it moves the blood. Unhappily for the progress of physiology, however, Aristotle believed that arteries and veins serve the same purpose [1] and bear blood equally to the extremities. Erroneous as was this idea the matter was made worse by Praxagoras, who wrote a generation later, and distinguished sharply between the functions of these two forms of blood-vessels, but distinguished wrongly.

Praxagoras observed that the arteries pulsate, while the veins lie apparently motionless. Thereupon, instead of recognizing the obvious fact that the movements of the arteries are due to the heart's impulse behind them, he asserted that the arteries beat because they are empty of blood, and are moved by a mysterious pneuma, to which he gave the name "vital spirits"—a pneuma much resembling air in character. We all know of this old error, but we must remember that it was an error quickly exploded. To be sure the conception of these air-tubes led to the adoption of the name *artery,* but the trachea also was dubbed artery, long before the name artery was applied to any vessel concerned with the circulation.

Galen was the medical philsopher who set straight the ancient misconception of the arteries' contents. One is tempted always to dwell upon the life and accomplishments of this extraordinary man—unquestionably the most distinguished medical scientist of the old world. But we must brush by him, noting merely that he died about the year 200 of our era. He studied and demonstrated physiological phenomena through animal experimentation. He proved beyond peradventure that both arteries and veins contain blood, and that the wounding of an artery or a vein may suffice to draw away all of the life stream. His knowledge of the nature of the circulation was at fault in many other regards, however; and as his views controlled medical beliefs for nearly sixty generations, and directed those beliefs into channels which now seem to us preposterous, it is worth our while briefly to glance at his teachings.

Galen and his successors were convinced that the system of veins springs from the liver, whence the venous blood draws its nutritive properties; and that the system of arteries springs from the heart. Those men recognized the fact that both veins and arteries mingle in the lungs, but the significance of that mingling they did not comprehend. Here is a fact, however, regarding these ancient men and their conceptions: The men seem never to have guessed, or even to have suspected the existence of that thing which we call the *circulation* of the blood. They named the arteries and veins—*blood-vessels,* the term which we still employ; but they used the word—*vessel*—to signify a blood container, a pitcher or a bowl as it were. The blood in these vessels—they thought—lies in them as water lies in a lake, and does not course through them as water flows in a river. One asks, naturally, how the blood, especially the blood of arteries, could be discharged in jets when the blood-vessel is wounded. Galen asserted that the arteries in themselves—in their own walls—contain a vital principle which causes them to dilate and contract. Strangely enough, he appears to have seen no special connection between the contractions of the heart and the throbbing of the arteries. He did realize, however, that there is probably some communication between the arteries and the veins; but he taught that this communication is mainly accomplished through the medium of minute openings in the ventricular septum of the heart, through which he imagined small portions of the blood-stream constantly to percolate. We know, indeed, that he used the word *anastomosis,* for Galen, as well as his predecessors in the Alexandrian School, believed that there is a communication between the terminal branches of both veins and arteries. Galen asserted this communication without being able to prove it; indeed, he demonstrated that this communication plays an important part in the bleeding to death of an animal and the exhausting of its veins, when an artery is opened; but in spite of the soundness of this conception he failed still to recognize the constant and inevitable round of the circulation.

So we have seen, as Fleurens[2] points out, that before Galen's time there were three principal errors in the conceptions of the circulation: the first, that the arteries contain air only; the second, that the ventricular septum is perforated; and finally, that the veins, as well as the arteries, carry blood to the extremities. Galen corrected the first error—the air error—but his false notions of the perforated septum and centrifugal function of the veins remained an accepted doctrine until after the Revival of Learning.

Curiously interesting is the return to a discussion of the circulation in the early years of the Renaissance. One of the great followers of Galen was Mundinus of Luzzi, who taught anatomy at Bologna in 1315. He reiterated Galen's story of the circulation and fixed it firmly in men's minds for more than three hundred years. In some sense he was our earliest modern comparative anatomist. Among other teachings he delivered himself of the following luminous statement: Man is to be distinguished from animals in that man has no tail, "because being naturally erect he rests himself by the sitting posture, and a tail would interfere with his sitting down." *Hec sufficiant de anatomia totius.*

We must recall also the shrewd Da Carpi who lived two hundred years after Mundinus, and followed closely his teachings. Da Carpi also taught anatomy at Bologna and distinguished himself by the astonishing discovery that men sometimes have been born with the heart covered with hair. On this account such men are braver than other peoples. In spite of this striking discovery, however, Da Carpi still clung tenaciously to the teachings of Galen.

Mundinus and Da Carpi were early prophets of the Italian schools, but a greater than they was to arise while Da Carpi was still living. This was Andreas Vesalius, the famous surgical anatomist, a Belgian by birth, who was called to the Chair of Anatomy at Padua in his twenty-third year. Vesalius is one of the most brilliant and attractive of our early heroes—the first great modern who refused to accept without demonstration the teachings of Galen. His work was done mainly in the anatomical theatre, and was concerned but indirectly with physiological problems. Vesalius came early to doubt those apocryphal percolations of the ventricular septum—" I still do not see how even the smallest quantity of blood can be transfused through the substance of the septum from the right ventricle to the left."

This great writer offered no explanation of the transference of blood from veins to arteries, but evidently he was impressed with the unreality of the accepted teachings and with the need of further study of the circulation. It is reasonable to suppose that his early retirement from teaching and his premature death postponed for a century the true explanation of the circulation.

Harvey, the distinguished English physiologist of the Seventeenth Century, is the man to whom we look as the discoverer of the circulation of the blood; and yet Harvey had that astonishing predecessor, Servetus, of whom too we hear too little. Servetus asserted the arteriovenous anastomosis in the lungs. He was a fiery soul—a bumptious opponent, a polemical disputant, always at odds with the authorities, whether civil, medical or theological. He was a Spaniard, born in 1510, four years before Vesalius; and Calvin burned him up at Geneva, when he was forty-three years old. Those were thorough-going days, and in this way the burning came about. Though a physiologist, an anatomist, and a rebel against the Galenic teachings, Servetus was animated chiefly by a hatred of churchly dogma, whether of the old or the new school. He used his own recently discovered physiological facts to overturn religious conceptions, and he wrote a book called "The Restitution of Christianity"—preaching a return to the primitive faith and life. He found that the Scriptures say the soul is in the blood, and that it gets into the blood through the air; but, to do this, the blood must circulate through the lungs, which indeed it does, says he. The venous blood does not percolate through the ventricular septum, "but by a grand device, the refined blood is driven from the right ventricle of the heart in a long course through the lungs. By the lungs it is prepared, assuming a bright color, and from the *vena arteriosa* it is transferred to the *arteria venosa*."

This was not the sum of his sinning, but at any rate the hard-fisted old Swiss reformer seized him when he found him in Geneva; and burned him up, with his books. Two copies only of the "Restitutio" have survived, so far as I know—one in the National Library in Paris, the other in the Imperial Royal Library in Vienna.

Various other commentators on the circulation lived in the time of Vesalius, but none, not even Vesalius himself, seems to have recognized the work or the existence of Servetus. Rialdo Columbus of Padua indeed reasserted, or rather, independently discovered the pulmonary circulation, and denied vigorously the common belief in an open ventricular septum—while Cæsalpinus of Pisa, towards the end of the Sixteenth Century, again described the complete flow of blood through the lungs, and devised the word *circulation*.

Although the three writers I have named last—Servetus, Columbus, and Cæsalpinus—asserted the fact of the pulmonary circulation, they asserted it from inferential reasoning, and not from demonstration; and mark this especially, that no one of them, save Cæsalpinus, had a word to say about the *general* circulation. Now Cæsalpinus in 1583 made this remarkable statement: Blood is conveyed to the heart by the veins; receives there its perfection, and this perfection being acquired, it is carried by the arteries to all parts of the body.[3] It is hard to see how this can be any other than a clear assertion that there is a *general* circulation. Unfortunately Cæsalpinus' contemporaries do not seem to have grasped the significance of his surprising assertion, if we accept the account of Fleurens, who brilliantly defended him some fifty years ago. Our own Dalton, writing in 1884, makes this astonishing comment on the work of Cæsalpinus: " It must be evident that there is nothing in this passage which would imply in Cæsalpinus a knowledge of the general circulation." This is an old controversy, important only, perhaps, to the medical historian. For myself, I cannot but believe that Cæsalpinus knew of what he wrote, and that we should take literally his writing.

We note one other name before coming down to Harvey himself. Fabricius ab Aquapendente in 1574 took note of the valves of the veins, but failed to perceive their significance in assisting the flow of venous blood towards the heart. He supposed they serve the purpose of little dams, constructed to oppose the too violent rush of venous blood from the heart to the extremities.

Then came Harvey, whose name marks the second period of interest in the history of the circulation. Three years ago Osler delivered the Harveian Oration on the " Growth of Truth," an oration so well known to us all that it is needless here to rehearse the orator's collected facts of Harvey's life and career. Suffice it only to remind you that Harvey was in Italy at the end of the Sixteenth Century, when the medical atmosphere of the Italian universities was charged with the new interest in physiological studies, and that he was an actual pupil of Fabricius, the discoverer of the vein valves. As Fleurens says, when Harvey appeared, everything relative to the circulation of the blood had been indicated or suspected; nothing had been established.

In the year 1616—fourteen years after his return home—

Harvey was made lecturer on anatomy at the College of Physicians in London; and in 1628, twelve years later, he published the first edition of his great work—even to-day a wonderful volume, though it is but a little book. Dalton writes of it: "This volume, a small quarto of seventy-two pages, undoubtedly contains a greater amount of important material in small compass than any other medical work ever published." Here we recall the facts merely that he took up *seriatim* the organs concerned with the circulation. He discussed the structure and action of the heart; the successive contractions of the auricles and ventricles; the passage of venous blood from the right auricle to the right ventricle and to the lungs; the passage of blood through the pulmonary vein to the left auricle, to the left ventricle, and to the aorta. He observed the valves, membranes and *ostiola* which are found at the entrance to each of the passages. He traced the blood through the arteries, and showed that the arterial pulsation depends upon the pulsation of the heart. Then he passed to the veins, and from a study of their valves drew the important deduction that venous blood can flow only *towards* the heart. He opened arteries in animals and perceived the rapid exhaustion of their blood, and the death from hemorrhage, from which he argued that blood circulates throughout the body with great rapidity.

One important step in the circulation, however, was not clear to him—the movement of the blood from the arteries to the veins through the capillary network, in both the general and the pulmonary circulation. He was convinced that in some way the blood does pass, and he conceived of a transudation through the parenchyma of organs,—a transudation, not through anatomical vessels, but through the structure of the tissues themselves. In this conception doubtless he followed the reasoning of Servetus, of Columbus, and of Cæsalpinus.

It remained for Anthony van Leeuwenhoek in 1688 to complete the story begun by Harvey. Here is Leeuwenhoek's graphic description of his first sight of terminal anastomosis. He studied with his crude microscope the organs of tadpoles, and was able to observe the flow of blood through their terminal arteries and capillaries. In a letter to the Royal Society of London, he exclaims with enthusiasm: "Having seen this many times to my great satisfaction, I would not keep the knowledge to myself, but I showed it to five distinguished gentlemen, who told me that they had never seen anything deserving so much to be seen. . . . We could not possibly have distinguished it, but as the blood consisted of a very clear liquid mixed with larger and smaller globules . . . so the observation of the circulation was the more distinct." Van Leeuwenhoek spoke the last great word in the story of the circulation.

With the establishment of an understanding of the circulation, there came about gradually a readjustment of the old conceptions of blood-vessel diseases and injuries and of their treatment; while the significance of hemorrhage, grave as that significance always had been, became still more appalling. I fancy that the poets and prophets of old time made more mention of the blood than did many of the philosophers and physiologists even. Vainly one searches the writings of Hippocrates for any word upon hemorrhage from wounds, and Celsus, who wrote in the year 50 A. D., says merely that one must apply lint dressings and must tie vessels which are obviously bleeding.

Since the complete round of the circulation was not appreciated in ancient times, the possibility of the body's emptying itself of blood was not apprehended. The fear of the old surgeons seems to have been merely that blood-vessels immediately adjoining the wound would become emptied. Doubtless it was through this misconception and through recognition of the occasional value of bleeding that the widespread practice of venesection[4] arose, which held bound conventional physicians for centuries, even after the actual discovery of the circulation.

The truth about the circulation of the blood had become acknowledged by all men at the beginning of the Eighteenth Century; but vital as was the truth, generations passed before surgical practice became modified. Indeed, the work of John Hunter in demonstrating collateral anastomosis about an occluded artery, was needed to bring home to surgeons the significance of a constant blood-stream.

The history of the *treatment of hemorrhage* up to recent times can be summed up in three words, pressure, cautery, and the ligature; yet one cannot study old writings without perceiving that these methods commonly were not satisfactory. The use of pressure went through many phases—packing, tenting, handpressure, bandaging, acupressure; though strangely enough the tourniquet, the popular pressure instrument of to-day for controlling serious hemorrhage, was not satisfactorily developed until the time of Petit in the middle of the Eighteenth Century.

The old surgeons liked to employ pressure as a hæmostatic. They found, that pressure continued long enough, checked nearly all forms of hemorrhage; and that hemorrhage checked by pressure rarely broke out secondarily. The old surgeons did not understand the reason for this absence of secondary hemorrhage after the use of pressure, though we now know that the reason as contrasted with ligature treatment lies in the frequent elimination from the wound of sepsis-causing foreign bodies. A striking and original pressure method was that advocated in 1869 by J. Y. Simpson in Great Britain—the acupressure method. Simpson realized the disadvantage of ligatures, which in his time were left with long ends protruding from the wounds, that they might be pulled off when the artery had sloughed, and he devised the acupressure pin, an instrument resembling a hatpin, which was passed in from the outside of the wound, and was made to compress the vessel for two or three days, or until the artery was completely blocked by natural processes. He then removed the pin, and in consequence left the wound free from external irritants. The familiar Wyeth pin used in hip and shoulder amputations is the acupressure pin of Simpson.

The cautery (the actual cautery) was needed to supplement the uses of pressure; and the story of the cautery wanders down through the history of surgery. If there were time, it would be interesting to quote Paré and his opinion of this barbarous hæmostatic. Paré could not stop its use, and the cautery continued to torture patients, to destroy valuable tissues, ineffectually to check hemorrhage, to create horrible sloughing, and to comfort the surgeon's conscience for generations after Paré's time. Indeed, the use of the cautery in its various forms was regarded as a fine art down nearly to our own day.

The ligature is one of the ancient devices of surgery. The Alexandrians used it before the Christian Era. Celsus commended it. Galen established its value for the control of vessels wounded in continuity; and finally Paré, in the middle of the Sixteenth Century, reintroduced it on the battle-field as *the* hæmostatic in amputations. The ligature was an improvement over the cautery and the equally barbarous boiling oil; but even so, the ligature was a constant source of danger, and an incentive to secondary hemorrhage until after the introduction of the principles of Lister.

J. F. D. Jones, an English surgeon of 1810, states: "The records of our profession afford us few and detached observations on the suppression of hemorrhage, if we contrast the knowledge we possess with the importance of the subject." A hundred years ago Jones produced a valuable book on this matter—a book dealing with the dangers of hemorrhage, its treatment by drugs, the operation of the ligature, and the nature of the healing of arteries; and his treatise contains fifteen remarkable plates which demonstrate the character of arterial wound-healing. Jones discourses at interesting length on the studies of other men upon hemorrhage and the nature of hemorrhage; and with commendable accuracy describes the knowledge of hemorrhage and its treatment as such knowledge existed in his time.

Such, as I have sketched them, were some of the measures used to combat active hemorrhage; but one finds also surgeons in all times endeavoring to correct the exhausting ill-effects of hemorrhage after the flow of blood had ceased—the employment of after-treatment, as we call it. Indeed, such stimulating and upbuilding measures always have been familiar, rational and effective, so far as history or legend carry us. Rest and nourishment, repose and stimulation—those for centuries were the means employed to bring back to health patients exhausted by hemorrhage. Freedom from apprehension, as well as freedom from pain, has always been recognized as supremely important. So we find Hippocrates and Celsus, Vesalius and Harvey, Paré and Wiseman prescribing supporting food, and enjoining soothing medicines. Andrew Blake a century ago wrote, "but opium is necessary . . . with the view of quieting tumult and where the pain is excessive."

Though such were the measures commonly used to check hemorrhage and to re-invigorate the body, wise surgeons and physiologists were appearing here and there, in ancient times even—wise men who looked for still more prompt and effective measures for restoring the lost strength and the lost blood. Since loss of blood was seen to be the immediate and obvious cause of the loss of strength, we expect to find surgeons seeking to put back *fresh blood* into the exhausted tissues,—and indeed, we do so find them.

All men know that our recent successful employment of *transfusion* is a revival and an improvement of a former practice; but few men realize that the conception, if not the practice, of transfusion is nearly as old as medical literature. In the development of much modern surgical progress we are going over the old ground and following the old steps in somewhat the same order as the ancients went and followed before us.

Modern surgery took up first the investigation and treatment of *gross and obvious lesions*—compound fracture; abscesses, and inflammations from infection—such as appendicitis; and tumors, innocent and malignant, such as ovarian cysts, uterine myomata and breast cancers. Then surgery expanded to concern itself with *derangements of organs*—ureteral obstruction, gall-bladder hypertrophy and pyloric stenosis. Next, in a burst of energy, it advanced upon the *more intimate seats of life;* it took up impaired nervous structures, brain tumors, and peripheral nerve lesions; and finally, inspired and strengthened by recent teachings in physiology, it has succeeded actually in repairing damage to the heart, in mending diseased nerves, in joining severed blood-vessels, and in replacing amputated organs and limbs. In the midst of all this enterprise there has been involved inevitably the question of *conserving the blood-stream;* and while we are concerning ourselves with questions of blood-vessel surgery, we are not forgetting the *Blood.*

The surgery of ancient times developed along lines parallel to the lines I have just sketched, and it reached many important conclusions and outposts. The thought, if not the practice of *transfusion,* was familiar to men of Virgil's time.

Oré,[5] the well-known French writer on transfusion, has discovered many references to the ancient use of blood-transference. He finds that it was employed among the early Egyptians; in the armies of the Roman Republic, and by the Jews of Bible times; while it is mentioned by Pliny, Celsus, Ovid, Libavius, Fabricius ab Aquapendente, Harvey, and sundry others.

Many of the older essayists on the history of transfusion speak of transfusion as though it had been performed commonly; but, indeed, there is no good evidence that it was ever systematically and intelligently performed until after the middle of the Seventeenth Century. There is one rather amusing and striking anecdote always related among the early cases of transfusion—the case of Pope Innocent VIII, who died in the year that Columbus discovered America. Writers, following the text of Sismondi, used solemnly to assert that the prelate, finding himself about to die, was persuaded by his Hebrew physician to consent to submit to the transfusion of blood, after the usage of certain practitioners, although they had never tried it "except on animals." Accordingly, three boys about ten years of age were bought, and their blood drawn. All three are said to have died at the beginning of the operation, probably from air embolism. In spite of these heroic efforts to save the pontiff, he himself died a few days later.

If the story is true, this is the first well-recorded instance of transfusion. Unfortunately, however, the critics have denied the anecdote; especially has Casse[6] denied it, who has written an entertaining monograph to prove the improbability of that old-time transfusion. Whatever the rights and wrongs of the tale, the fact remains that the thought of transfusion, especially as between animals, was familiar to surgeons of the Renaissance.

On June 15, 1667, nearly two hundred years after the lamentable demise of the three Italian boys, Jean Denys in Paris tried transfusion in man for the first time in French history. Although the experiment seems to have succeeded, the community was roused to an extraordinary pitch of excitement, and opposing factions were formed—these praising and those abusing the novel undertaking. Finally, after a year, the civil authorities took the matter in hand and formally prohibited transfusion in human beings.

Almost at the same time, in 1668, during the reign of Charles II, the Englishmen Lower, King, and Wren, the Italians Riva and Manfredi, and the Germans Kaufmann and Purmann, succeeded in transfusing blood from man to man. All of these experimenters used an extremely crude and dangerous method. They drew venous blood from the donor, received it in a vessel, and then poured it through a tube or catheter into a vein of the patient. The inevitable accidents happened; clots and air were introduced into the circulation of the sick man; little benefit resulted, and an occasional death was reported. The operators became discouraged and the community alarmed. The procedure came into contempt. This outcome was a grievous disappointment to enthusiasts, for the thought of transfusing vigorous blood had aroused tremendous interest and hysterical hopes,—the sick were to be made well; the old were to be made young, and perpetual youth was to become the happy lot of all men.

Shattered hopes were not revived for many generations. Early in the Nineteenth Century, after nearly one hundred and fifty years, Blondell and Doubleday, the Englishmen, instituted again transfusion by a successful operation on a woman dying of postpartum hemorrhage. Recent interest in the procedure dates from that year, 1818, the beginning of the modern, or *third period* of transfusion history, as Oré calls it.

Blondell was indeed experimenting in a field practically untrod; but he reached conclusions of striking importance, if only they might always have been proven true—that the passage of blood through a syringe does not curtail the blood's functions; that small quantities of air in the veins do not especially endanger the life of the patient; that blood transference from artery to vein is hazardous; and that human blood transferred to a dog may kill the latter. Two years later, Prévost and Dumas, after a series of experiments, were able to assert that immediate transfusion through a tube may properly be made from the artery of one animal to the vein of another.

The third transfusion period lasted for more than half a century. It covered the years from those early experiments of Blondell's to the time of the firm establishment of aseptic surgery—that is, to about the year 1885. During this era a great deal of interest regarding transfusion was written and was said. Pect, in 1841; Soden, in 1852; and Higginson, in 1857, urged vigorously the value of transfusion, and discussed various methods of employing it. Especially Bischoff, in 1835, urged the value of defibrinating the blood drawn, and then injecting it by the indirect method, that is by collecting it in a vessel and then passing it through a tube into the patient—as contrasted with the direct method, the passing of blood from donor to recipient through a short intervening tube only. Many surgeons were convinced that Bischoff's practice of using defibrinated blood marked a revolution in surgical therapeutics, and his method was extensively tried throughout Europe.

Numerous ingenious apparatus were devised; one of the best perhaps being the funnel of Higginson, which was so constructed as to keep the blood warm in a hot-water chamber—while Brown-Séquard, in America in 1857, carried the process further by oxygenating the blood before injecting it.

In 1871, De Belina, in Paris, gave a further impetus to the use of transfusion by important studies and clinical demonstrations, and wrote these words: "Not only do these cases show in an inevitable manner the value of transfusion in post-hemorrhagic anæmias, but also in asphyxia and eclampsia; and open a vast field to those future experimenters who shall profit by what has already been accomplished."

The discussion and enthusiastic work went on. Roussel of Geneva, in 1876, had become a recognized authority on transfusion. This earnest writer returned to the direct method and asserted that transfusing blood can mean only conducting without interruption and without contact with modifying agents, the living and unaltered blood, from one organism to another, so that it can produce all those vital effects which constitute the real rôle of the blood: and to this end a transfusing apparatus should be a direct anastomosis only from one vascular system to another. This illuminating statement gives us pause, and we think we have leaped at once to the latest modern method; but we find that Roussel did not look ahead so far. His direct anastomosis was through what he called an "artificial heart." To-day we should content ourselves with the more familiar name—Davidson syringe. He used what was in effect that familiar syringe, made of "pure unadulterated india-rubber," for which he claimed great virtues; and he pumped 200 Grams of blood from vein to vein in five minutes. Incidentally, we learn from Roussel's article, that the governments of Belgium, Austria, and Russia had already at that time (1876) furnished their army surgeons with a good transfuser, from which we are to suppose he means his own transfuser.

All the writers in what I have called the third period of transfusion seem to have had a sound understanding of the physiology of the procedure. They recognized not only the value of fresh blood *per se,* but the importance of fluid in bulk supplied to the exhausted circulation. Few of them, however, if we except Roussel, transfused large quantities of blood. For example, P. T. Morton, of the Pennsylvania Hospital, in 1874, writes of eleven ounces of blood as the largest amount that he had ever transfused, and his experience was considerable; while he states that he has known two ounces to stimulate the heart and save life when that life was on the verge of extinction.

All the writers speak of the numerous conditions in which transfusion is of benefit—for exhausting hemorrhage, whether from wounds, from childbirth, or from gastric and intestinal ulcer; for asphyxia of the new-born; in illuminating gas-poisoning; in chronic anæmia, whether primary or secondary; in epilepsy; septicæmia; uræmic poisoning,—and in all these and similar cases they urge the performance of transfusion early—not waiting until the patient is at the point of death.

About thirty years ago, numerous experimenters began to advocate the employment of fluids other than human blood for infusion. So long ago as 1830,[7] Jœnichen of Moscow practiced and advocated intravenous saline infusions in cases of persons dying of asphyxia; while Roussel, in 1876, pointed out the propriety of employing the term *transfusion* to indicate blood-transference only—the term *infusion* to indicate the injection into the body of some substance other than blood. The suggestion of Jœnichen was adopted by numerous investigators: Schiff and Gaule demonstrated the value of saline infusions in cases of acute anæmia; Bischoff, the same who advocated the employment of defibrinated blood, made a brilliant success with the injection of saline solution, an agent which numerous other experimenters down to our own time have shown to be of life-saving value.

In the early days of the use of saline infusions, and later, nearly up to twenty years ago, certain enthusiastic surgeons asserted, and with great show of reason, that salt solution was far preferable to blood as a vehicle of cardiac stimulation. In some sense and for obvious reasons, these assertions were true, for salt solution is readily obtained, and is safely employed. No physiologist, however, could admit any intrinsic superiority in salt solution over blood. Eighteen years ago, Matas expressed the situation correctly in saying that *mechanically* or *physically* saline infusions are the rivals or equivalents of blood infusions, while, *physiologically,* salt solutions never can rival or equal blood.

It is extremely interesting to read in this early writing of Matas (1891) these words also: "In speaking of blood as a medium for transfusion, we mean, of course, only pure, entire, living blood, and not the altered pathological material, known as defibrinated blood. We also mean blood of the same species, and not that derived from heterogeneous sources." This last statement, which suggests a knowledge of the hæmolyzing effect of blood of different species, had first been enunciated by Panum, writing in Virchow's *Archives,* and quoted in 1871 by De Belina, who makes this interesting statement: "The bloods of animals can revive animals of a different species, but only as a result of its passage. It decomposes at once, and if it has been injected in small amounts can be eliminated without causing disturbance; but if it has been injected in large amounts, it can cause death."

The convictions of Matas, expressed eighteen years ago, as I have quoted them, are the convictions to-day of surgeons the world over. We all use saline infusions in cases of hemorrhage, after the bleeding has been checked, as well as for various other accidents threatening life. At times we supplement the simple saline by fortifying it with adrenalin, but our principal proposition maintains: we need to support by the bulk of the injection the vital or central avenues of the circulation, the heart and the blood-vessels in the trunk and in the brain.

The whole subject of the value of saline infusions in the treatment of hemorrhage is too familiar to need repetition, especially in view of the elaborate work of Crile and Dolley, which they sum up in an admirable paper published three years ago.[8] Those writers refer briefly and almost casually to two important facts regarding the use of saline infusions—two facts which indicate the limits of its value, and mark off sharply its physiological action from that of transfused blood: (1) In the case of an anæmic heart, there is always a possibility, or the probability even, that an intravenous infusion may precipitate an acute cardiac dilatation. When the pulse-wave is large, when the pulse-resistance is slight and the rhythm slow, we must use infusions with extreme caution. (2) The blood does not tolerate great dilution. Large amounts of salt solution pass quickly through the great blood-vessels, and accumulate in the lungs, the pleural cavity, and the abdomen, with the result that the patient not only loses the benefit of the salt solution in his circulation, but may chance to find himself seriously embarrassed by abnormal accumulations of fluid in the trunk cavities.

Thirty and more years ago, surgeons were not satisfied that saline solution was the best agent to accomplish the benefits of which we now know it capable. They experimented with many other agents and with apparent success—with weak solutions of albumin, of bicarbonate of soda, of glycerin, and of milk.* T. Gaillard Thomas especially, in 1878, reported a series of remarkably interesting results from the infusion of milk,[9] and stated—a fact often forgotten—that this novel agent was first employed on man for infusion so long ago as 1850 by Edward M. Hodder, of Toronto. Hodder had given as much as fourteen ounces of milk at a single injection; but Thomas convinced himself that eight ounces is the limit of safety. These experimenters and others found that absolutely fresh and sterile milk should be used, as decomposing milk quickly causes death. Thomas collected twelve cases of milk-injection, and wound up his paper with the following rather pathetic statement: "I should be false to my own convictions if I did not predict for 'Intravenous Lacteal Injection' a brilliant and useful future."

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* The history of milk injection can be traced back to the year 1667, when Johannes de Muralto of Zurich practiced the injection of milk into the vessels of one of the lower animals. Statement by August Schachner in the American Medical Practitioner and News, October 31, 1896.

In spite of such rather freakish and bizarre experiments, the value of infusions of some sort continued to attract the confidence of the profession, but by 1890, the saline infusion had taken a front place as the one safe and available agent.

Saline infusions, however, have not always been given in one and the same manner. For example, Johnson-Alloway employed successfully in a case of desperate collapse from hemorrhage, the infusion of salt solution into the peritoneal cavity—injecting three quarts at a temperature of 110°, through a glass drainage tube, when he found that this fluid was taken up rapidly by the exhausted circulation; while Dawbarn in 1892, and H. A. Kelly in 1894, advocated the injection of saline infusion directly into an artery. Dawbarn devised the technic of inserting a hypodermic needle into the femoral artery, and sending the infusion through the needle by the force of a Davidson syringe—the fluid at a temperature of not less than 120° F. This writer maintained at the time that two quarts at least should be injected. Kelly infused a litre of salt solution *centrally* into the radial artery of his patient, forcing the fluid towards the heart through a cannula introduced into the artery. Both of these experimenters were satisfied of the value of arterial infusion, claiming for it a quicker action than when the solution was injected in the ordinary way into a vein.

H. T. Hanks, of New York, writing in 1898, remarks: "Just how this simple salt solution acts in arteries may not be fully understood, but it is certain that the heart responds at once to the presence of the fluid. The cardiac and arterial ganglia are stimulated, whether the fluid is stimulating or not. . . . The additional fluid in the arteries certainly pushes on the half-stagnated capillary circulation, clearing out what would in a short time become semi-poisonous in itself. . . . The flushing out of the smallest blood-vessels by this diluted fluid is a virtue in itself."

Dawbarn makes this further note: "I need hardly add here that *blood-transfusion*, either mediate or immediate, has now been dropped by almost all surgeons. When a person has bled to death, more than half the blood still remains in the body; and if this is properly increased in bulk by any innocent fluid, this added bulk is all that the heart needs to make it resume work." But note Schachner of Louisville, who stated in 1896 that transfusion of blood proper, though regarded by different writers as both safe and unsafe, can no doubt in the hands of a careful operator be made free from danger. He remarks, however: "From the history of transfusion it is apparent that formerly its range of application was far more extensive than its merits justified." Schachner says further, that the publication in 1891 of E. Schwartz, "On the Value of Salt Infusion in Cases of Acute Anemia," established the modern confidence in salt infusion.

We see then as a result of our researches that about the beginning of the present century surgical opinion had crystallized into the belief that blood infusions are hazardous, and that salt infusions are satisfactory and life-saving, because what is wanted is an increased intravascular pressure; that in some cases of alarming hemorrhage, infusion should be supplemented by transfusion with defibrinated blood; that the indications for infusion include any pathological state attended with a feeble pulse, and with shock; that the improvement of the circulation after infusion is due in part also to the stimulating influence which the hot salt solution has upon the heart, while at the same time "auto-infusion," a forcing of the blood by bandages from the patients extremities toward his centres, is an extremely useful manœuvre.

Every surgeon of a few years' experience recollects that such conceptions were held to be sound and such practices satisfactory a very few years ago; and he knows that in most emergencies such measures still suffice.

Within the past ten years, with the additional light thrown upon the nature of shock and on the effects of hemorrhage—our conception of a paralyzed or of an exhausted vasomotor centre—we have come to see that something more than the mere presence of salt solution in the blood-vessels sometimes is necessary to restore a depleted circulation; while the observation that excessive amounts of saline solution in the vessels may paralyze an enfeebled heart, or may be exuded into the cavities of the trunk, has brought about successful attempts to return to a more rational employment of the long-neglected blood transfusions.

It is a fortunate and interesting fact that with this swing of the pendulum, with this turning back towards an endeavor to utilize the blood itself, a flood of new light has been shed recently upon the surgery of the blood-vessels. Our knowledge of the healing of veins and arteries has been broadened, while at the same time we have learned the entirely novel fact that blood-vessels under proper conditions themselves may be repaired and anastomosed, so as to continue their normal functions. Taking advantage of this new knowledge, we have been enabled to make good the half-completed undertaking of Roussel the Swiss investigator, who asserted more than thirty years ago, that true transfusion means the passage of sound or unaltered blood from the arterial system of the donor to the venous system of the donee.

We are now approaching so vast, so intricate and so fascinating a theme that one may not properly in a brief paper do more than suggest the lines upon which studies of the blood in surgery are developing. Less than two years ago, Stephen H. Watts of the Johns Hopkins Hospital collected in a luminous monograph a statement of accomplishments in blood-vessel surgery up to that time. Since then further progress has been made—progress strikingly picturesque if not more practically important. The list of laborers in this field is already great. Watts gave us a bibliography of eighty-three numbers, and this bibliography to-day could be doubled. We in this country look especially to Abbe, J. B. Murphy, Carrel, Guthrie, Matas, Dorrance, and Crile for information on these matters. Indeed, there are many others, while the list of European investigators is a long one.

The first and most striking fact in *blood-vessel healing* soundly demonstrated by these investigators, is the fact of the ready adhesion of intima to intima, directly reversing the principle upon which the *intestinal tube* is sutured—serosa to serosa. For some time it seemed as though the necessity of applying intima to intima in small friable blood-vessels would oppose a serious obstacle to the progress of vascular surgery; but thanks to the sound demonstrations of Carrel and of Guthrie, we have now been furnished with a simple and reliable technic, which answers practical purposes. We have learned further that for the handling of blood-vessels special training is required, and the employment of special agents—constant and proper lubricants, constant and unfailing warmth and moisture, and delicately and accurately applied needles and suture materials.

The surgeon who hastily and confidently undertakes any considerable work on the blood-vessels finds to his chagrin that the operation is anything but easy. We talk lightly of arteriovenous anastomosis and of transfusion by the method of Carrel or of Crile, but the novice at such work will find himself floundering in clumsy perplexity, and will exhaust hours of strength and patience unless he has equipped himself for the task through painstaking and faithful experiments on animals in the research laboratory.

For years Crile has taken the keen interest of a surgical physiologist in the nature and treatment of shock in hemorrhage. It was to be expected, therefore, that the development of blood-vessel surgery should suggest to him as to others the feasibility of practicing blood transfusion by utilizing our recently acquired knowledge of blood-vessel surgery. In July, 1906, he published one of his most extensive articles on the treatment of shock and hemorrhage through the use of *saline* infusions. In November of the same year he published his first article on the "Direct Transfusion of Blood in the Treatment of Hemorrhage."[10] On April 20, 1907, he demonstrated on a patient before the Society of Clinical Surgery his method of transfusing blood.

Already at that time others had become interested in this important work, and now some hundreds of cases have been collected. It is needless here to suggest the types of cases which are benefitted by this operation further than to state that the transference of blood from donor to patient is not limited by any means to that class of cases which are commonly called surgical. The treatment will benefit a great variety of persons who suffer from a diminished quantity of blood, or from an inferior quality of blood. One sees, of course, the value of refilling a circulation exhausted by hemorrhage, but frequent observations teach us that something more than the mere bulk of the blood benefits the patient.

Many observers, from Alexander Schmidt and Kohler to the investigators of our own time, especially Weil, Richet, and Leary, have pointed out that certain properties in serum, whether of animals or man, exercise a coagulating influence on the blood in cases of chronic hemorrhage. These observers have not been able to show, however, that the sera employed invariably act beneficially. On the other hand, small amounts of whole human blood transfused to a patient who suffers from repeated hemorrhages are sometimes found to shorten his coagulation time as well as to check the habit of bleeding.

Last spring I had a patient who illustrated the above fact: A girl of twelve who had passed through her first three menstrual periods with alarming bleeding at each, at the time of her second period, on the advice of Leary, was given 15 c.c. of rabbit serum by hypodermic injection. Leary noticed that blood oozed afterwards from the needle punctures for half an hour. Two days later the injection of serum was repeated, but was followed by no oozing from the needle punctures. Her next menstrual period was of the same character, and was treated successfully with guinea-pig serum. With the next, or fourth period, in May, 1908, she bled until nearly exsanguinated, when I was called to see her. She was in an alarming condition—waxy, nearly pulseless, prostrated, after ten days of continual bleeding. I transfused to her from a vigorous young man, her cousin, about six ounces of blood. Her bleeding ceased immediately, and within three weeks she was well; but the notable fact in the case is that since May, 1908, more than twelve months ago, she has had the normal catamenia of a girl of her age.

Internists as well as surgeons are beginning to appreciate that the transference of blood is becoming an important therapeutic measure—but a measure whose ultimate value is not yet determined. The technic of blood transference is still somewhat debated—whether to use the direct suture of Carrel, or some mechanical device such as that of Crile, of Ottenberg, or of Levin.

At the same time that the therapeutic employment of transfusion is revived, doubts of its universal applicability are raised through modern knowledge of the nature of the blood and the blood content. *Iso-agglutination* and *hæmolysis* are terms which express conditions with which we must reckon.

By *iso-agglutination* we mean the clumping of the blood corpuscles of one person by the serum of another, and this phenomenon may have an important bearing on blood transfusion, for iso-agglutination suggests, as Hektoen pointed out two years ago,[11] that under special conditions homologous transfusion might prove dangerous by leading to erythrocytic agglutination within the vessels to which blood was transfused. Hektoen suggests that this possible danger can be avoided by the selection of a donor whose corpuscles are not agglutinated by the serum of the recipient; and whose serum in turn does not agglutinate the corpuscles of the latter.

The condition *hæmolysis* raises quite another question—a question the subject of much careful study during the past five years, and admirably summarized by Richard Weil in the *Journal of Medical Research* for October, 1908. Hæmolysis depends upon the fact that a red blood corpuscle is covered by a delicate membrane which is easily susceptible to change or destruction; and that when the membrane is so destroyed the important contents of the corpuscle, notably the hæmoglobin, escape. This destructive process is known as hæmolysis, and agents causing hæmolysis are termed hæmolysins. Among the organic hæmolysins are the blood and tissue juices of alien species, and notably the blood and tissue juices of the same species when subject to certain pathological conditions. For example, in pernicious anæmia, in certain fevers, sometimes in chronic suppuration, and in certain cases of malignant tumors, there is such a change in the blood serum of the patient that his abnormal serum will hæmolyze the red corpuscles of a normal individual of the same species.

This phenomenon and the technic of the corresponding investigations are outside further discussion in this paper. but the significance is apparent, as well as the importance of determining hæmolysis in cases subject to transfusion. Moreover, the fact of hæmolysis may become, as we know, a suggestive factor in determining obscure diagnosis. Says Crile:[12] "Our conclusion is that hæmolysis occurs in a number of diseases. It occurs in great frequency in cancer and tuberculosis. The reaction in tuberculosis is the reverse of that for cancer." *

In view of the struggles of our predecessors to establish, make available, and popularize blood transfusion, and in view of their ardor and their recurring failures, the recently ascertained facts regarding the nature of the constituents of the blood are extremely illuminating. Denys, Lower, Kaufmann and their contemporaries failed successively to establish transfusion because they could not control clotting and air embolism. Blondell, Dumas, and their contemporaries in the last century failed to realize the danger of employing the blood of alien species; while Bischoff started the practice of defibrination, which for years led away his successors on a false trail. Brown-Séquard and his associates do not seem to have guessed even the intricate processes which mixed bloods may precipitate. The problem of transfusion is still by way of solution; the indications and the straight road are not always obvious. Our ancestors looked to transfusion for rejuvenescence and

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* Wyman Whittemore, working in the laboratory of the Massachusetts General Hospital, writes (Boston Med. and Surg. Jour., Jan. 21, 1909): "From these results, at the present time, hæmolysis is of no value in the diagnosis of carcinoma."

perpetual youth; we, in a more modest generation, may look to transfusion for the re-establishment of health in certain cases which hitherto we have often deemed hopeless.

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THE TWO-STAGE PRINCIPLE IN OPERATIVE SURGERY.*

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Striving toward perfection in surgery, we must make every effort to master the art of operating; yet our final goal is always the security of the patient. Our motto might well stand:

Not how skilful but how safe.

It is almost axiomatic that in technical skill practice indeed makes perfect. The axiom, however, is not always so evident in the matter of judgment, for here much depends upon individual powers of observation and upon that logical and judicial quality of the intellect which enables one to comprehend cause and effect. In following the course of a surgical disease with its multitude of complicated incidents the fitting together of related phenomena often enough becomes a task beyond the power of human mind.

Reviewing the causes of danger and of death in the operations of surgery we come upon three factors which are of paramount importance. These are the anæsthetic, the excessive loss of blood, and shock. Sepsis need not be here considered since, when directly due to the operation, it is after all a secondary and more avoidable source of peril; and when sepsis is present before the operation surgery is called in to overcome it.

We will first take up the matter of anæsthesia. It is quite certain that in spite of the utmost precaution a percentage of mortality is directly due to anæsthetic poisons. This is not denied by the most expert anæsthetists and, indeed, they are the very ones to sound the note of warning and to point out the necessity for care and experience in this branch of surgery. It follows, therefore, that in considering the dangers of any operation, the duration of anæsthesia as well as the variety and amount or dosage of the narcotic itself must be kept in mind. We must remember that the shorter the anæsthesia and the smaller the quantity of the drug used at one time the less will be the danger. If an operation promises to be of long duration, and if the saving of time is recognized as an important element, then we should consider the advisability of doing the work in two stages even though the total time of anæsthesia for the two stages be greater than that of the operation performed at one sitting. A quantity of narcotic may be taken with safety in divided doses which would surely prove lethal if taken at once.

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* Read before the New York Surgical Society, October 13, 1909.

Excessive Hemorrhage.—The acute anæmia resulting from loss of blood at an operation is a frequent source of great danger and of death. It is best to avoid even the near approach of peril and, whenever possible, to stop the operation when hemorrhage causes the patient's condition to become alarming. The observation of the blood pressure is of much value and the warning of the sphygmomanometer should not be disregarded. Better surely operate twice or three times with safety than take unwarrantable risk in order to finish at one sitting the work and perhaps the patient.

Shock.—Shock may be the result of hemorrhage, or it may be caused by manipulation of vital organs, or it may be the direct sequel of operations which have been unduly prolonged. Shock may be directly caused also by profound mental impressions attendant upon the scenes and experiences connected with operations even when performed without the aid of narcosis. Indeed, one of the greatest boons of anæsthesia is the doing away with the psychical as well as the physical impressions upon the patient during the progress of surgical work.

Reasoning from the foregoing statements, the conclusion is inevitable that the cause of safety in surgery will be distinctly advanced, first, by using the smallest necessary amount of the anæsthetic; secondly, by avoiding excessive hemorrhage; thirdly, by shortening the actual time of operation.

For a number of years I have been convinced that one or another or all of these safeguards may be secured in certain operations by performing them in two or more stages. And, moreover, I would suggest that in planning any serious operation the possibility of the lessened risk by this method should be considered. When, for sound surgical reasons, the division of the operation has been decided upon, the wishes of the patient or his friends should be disregarded if a single-stage operation is urged in order to be through with a disagreeable experience. On one or two occasions I have regretted bitterly doing too much at one time, but I have never regretted dividing the operation.

I am well aware that many good surgeons will look with scorn upon this indication of apparent timidity, just as some regard the preliminary ligation of arteries as a confession of uncertainty in the technic of hæmostasis. What we are all working for, however, is to save the patient,—to jeopardize him as little as possible. Often an operator will consider a procedure safe for one subject but not for another. Quite true. Then why be more reckless simply because the individual may seem capable of enduring an exceptional strain? The certainty of *preserving life* is the most important reason for the existence of surgery, though we are not unmindful of the other great branch, namely, to render life more desirable.

In some operations the two-stage principle has long been recognized,—for example, in the older methods of performing cholecystostomy and colostomy. My plea, however, is for the more general acceptance of the doctrine in all operations which might be called extra hazardous and which, at the same time, lend themselves to a natural division into well-marked steps or stages. The tender-hearted person who could not cut off the dog's tail at once but who managed to accomplish the result by removing an inch at a time may have multiplied pain in his feeble-minded endeavor, but he unconsciously subscribed to the theory well known to our forefathers in medicine, that the shock of an amputation increases in direct proportion to the proximity of the plane of section to the trunk of the individual.

In this paper I shall briefly discuss certain typical operations which appear to me particularly suitable for division into stages, but will not refer to those which from their very nature must occupy many sittings; such, for example, as complicated plastic work.

OPERATIONS WHICH ARE SUITABLE FOR DIVISION INTO TWO OR MORE STAGES.

1. For intracranial disease.
2. For intrapulmonary disease.
3. For obstruction of the bile passages.
4. For obstruction at the pylorus.
5. For malignant disease of the rectum.
6. For hypertrophy of the prostate.
7. For suppuration in the kidney (nephrectomy).

Intracranial Operations.—Hartley has pointed out that infection in operations upon the cranial contents occurs in direct proportion to the necessity for drainage. It would therefore seem that except in cases in which infection previously exists complete closure of the entire wound reduces the danger of sepsis. It follows that in operations for intracranial growths, for neurectomy and in similar procedures, completion of the operation in one stage promises the best results. It must, however, be recognized that some of these operations are accompanied by such profound shock as demonstrated by lowered blood pressure, whether due to hemorrhage or to interference with the vital centres, that completion of the operation signifies unwarrantable risk. If the work has been well planned, so that it may cease at any moment, the operation can be stopped, the wound *completely* closed and the patient sent back to bed to await reestablishment of his equilibrium. A second or even a third sitting is then to be regarded as a separate operation. The danger is thus safely distributed so far as shock is concerned, although it is naturally doubled or trebled in regard to the more avoidable accident of sepsis.

Operations upon the Lungs.—In the absence of apparatus for pneumatic differentiation, the extirpation of tumors of the lung and the evacuation of pulmonary abscesses, as well as cutting operations for the removal of foreign bodies, can be performed best by the two-stage method. The first step is for the purpose of accomplishing the local adhesion of visceral and parietal pleura, either by means of suture or by the formation of aseptic inflammatory exudate such as that following the application of zinc chloride solution to the unopened parietal pleura. The adhesion gives us a field for performing the pneumonotomy proper without the risk of the septic invasion of the entire pleural sac. And, indeed, it is probable that even with the help of apparatus for negative or positive pressure septic work on the lung will be less dangerous if the operation is divided. The pleura is extremely subject to acute spreading infections from very slight unsterile trauma. Then, too, we have here the added risk of pneumothorax.

Operations for the Relief of Biliary Obstructions.—In prolonged icterus, especially when there are cirrhotic changes in the liver, even slight operative interference is apt to be followed by fatal recurrent or secondary hæmorrhagic oozing. To be sure, a few precautions may be taken to shorten the coagulation time of the blood,—such, for example, as the injection of alien serum before the operation. From personal experience, however, I am of the opinion that in operations of magnitude the danger of hemorrhage continues long after the good effects of the alien serum have disappeared. The safer mode of procedure, then, when deep chronic jaundice is present, is to employ serum or other therapy and to operate by the shortest and simplest possible method merely for the relief of cholæmia, reserving the removal of the cause of obstruction until a later operation.

My practice is to perform cholecystostomy for drainage and to do this in one stage through a small incision; and to avoid all unnecessary irritation of peritoneum whether by handling or packing. When the patient is in very poor general condition and when the obstruction partially yields after the cholecystostomy, as evidenced by the presence of bile in the stools, there is no reason whatever for hastening the second step. In the case of very old persons or those who have shown that they bear operations badly, it is best to continue biliary drainage indefinitely or even permanently. For this purpose I use a little flexible solid rubber plug with a core of copper wire which permits the plug to retain any desired curve. At the distal extremity of the plug there is a thin pliable flange about two inches in diameter, which neatly adapts itself to the curve of the abdominal surface. About a half inch from the flange there is a bulbous enlargement of the stem which fits so firmly in the sinus itself that no bile or other discharge can escape. The diameter of the stem is about 14 to 16 French scale and the bulbous portion is two sizes larger. The total length of the appliance must depend upon the distance of the viscus to be drained from the abdominal wall—considerably greater in obese than in emaciated persons. The plug may be held in place by a strip of adhesive plaster and its presence is not a source of discomfort. It may be removed and cleansed once a day and in the event of a colicky attack due to closure of the cystic or common duct relief will be at once experienced on removal of the plug. I have patients who have been comfortable for years with simple drainage, preferring the condition to the dangers of a radical operation.

Pylorectomy.—It appears to be pretty clearly proved that the safest method for performing this operation is by a combined extirpation of the pyloric region of the stomach and duodenum with complete closure of both open ends, followed by a gastro-enterostomy to act as an artificial pylorus.

It has been the custom to perform both these operations at one sitting. I would suggest, however, a plan which I have tested and will certainly make my rule, namely, to divide the operation. The advantages are several. The first and most important one is that in starved and emaciated persons the short and simple gastro-enterostomy is followed by an enormous improvement in the general nutrition and in strength, so that the pylorectomy itself becomes a far less shocking operation than it would have been without the preliminary step. Then, too, the second operation is often considerably shortened and is rendered easier by the subsidence of inflammatory thickening and adhesion about the neoplasm. I have seen a tumor the size of a large duck's egg disappear *completely* in the two weeks following gastro-enterostomy. At the second laparotomy the parts were carefully examined and not a trace of tumor or adhesion could be found, so the proposed pylorectomy was for the time abandoned, the patient being warned to report at once any symptoms of relapse. Naturally, this tumor could not have been neoplastic, but it was probably inflammatory due to the threatened perforation of an ulcer. If I had a similar case to treat I would remove the pylorus in any event.

Extirpation of Malignant Growth of Rectum.—With preliminary colostomy for exclusion of the rectum the symptoms due to the continued functioning of the diseased organ are greatly ameliorated. Also the general condition of the individual thus relieved becomes so much improved that extirpation of the tumor or amputation of the rectum by any method becomes a good surgical risk, whereas before the colostomy the danger might have been prohibitive. At the same time, the preliminary abdominal section will afford a good opportunity for the examination of the upper limits of the neoplasm and the adjacent organs, so that the advisability of the radical operation as a further step can be determined. A year or two of life is far preferable, surgically speaking, to a death resulting from an attempted radical cure. I have more than once had occasion to note both the advantageousness of the preliminary colostomy and the unfortunate results of the attempted extirpation of an inoperable tumor without preliminary colostomy.

One case impressed me profoundly. It appeared to be a simple matter to remove a non-adherent tumor situated high in the rectum but demanding resection of bowel. A laparotomy for colostomy revealed numerous unexpected metastases, some of which were in the liver,—a condition which would have rendered any operation of greater magnitude a surgical crime.

Suprapubic Prostatectomy.—It is not my purpose to enter here upon a discussion of the various routes of approach. My personal opinion is, as stated elsewhere, that the suprapubic is the preferable operation in the vast majority of instances. One of the most cogent reasons for advising this route is that it lends itself ideally to the two-stage operation. Even in the feeblest individuals the opening of the pneumatically distended bladder with the aid of local anæsthesia is an extremely short, simple and safe piece of work. We are then in a position to understand fully the exact conditions which cause the obstructive symptoms, and we may also explore, by sight if desired, the entire vesical wall including the ureteral and urethral orifices. Diverticula, tumors, and calculi—whether encysted or not—will be discovered. They may be dealt with at once or later, or not at all. Whether or not there is infection causing cystitis the troubles caused by the distressing periodic attempts to empty the bladder are done away with at once. Knowing that we are to have the opportunity of this surgical and exact exploration it is unnecessary to do a preliminary cystoscopy, often in these cases a painful and even dangerous procedure.

Shock following cystostomy is extremely rare. The patient is out of bed the following day and may even be permitted to be upon his feet for a few minutes at a time. The second stage of the operation, enucleation of the prostatic growth, need not be undertaken until the patient's condition has so far improved that he can with reasonable certainty bear a general anæsthesia of from five to ten minutes.

Many of these patients being affected with arteriosclerosis are apt to bleed, and if the operation has been done in two stages great embarrassment may be avoided, since the surgeon will know the exact location of the hemorrhage. After the first stage this will be in the abdominal part of the wound. After the enucleation any bleeding which occurs will almost invariably come from the prostatic wound. When the work is done in one stage there are two places which may be expected to bleed, and the determination of the location of the hemorrhage is always troublesome, often difficult, and sometimes necessitates another anæsthesia,—surely a disquieting and frequently a dangerous proceeding.

Should we be unfortunate enough to lose the patient after the cystotomy it is mathematically more probable that he would have succumbed after a cystotomy *plus prostatectomy*.

These are the most important advantages of the operation of suprapubic prostatectomy in two stages. All the good points of the suprapubic route need not here be enumerated.

Nephrectomy for Renal Suppuration.—Removal of the kidney weeks or months after surgical drainage of the organ is usually difficult and dangerous because of dense adhesions to neighboring important structures. Indeed, secondary nephrectomy is so fraught with peril that many surgeons rate its mortality many per cent. higher than that of the primary form of the operation. Yet the removal of a large pus kidney with the flooding of the great fresh wound with enormous quantities of septic fluid is an extremely serious matter and is usually accompanied by great hazard.

Now, if we content ourselves with an ample incision for drainage and exploration, it will be noted that at the expiration of a week the sepsis will have become less severe, the tumor mass will have greatly diminished in size and nephrectomy may be quickly and easily performed, the entire operation consuming, say, from five to ten minutes. The adhesions, instead of being tough and fibrous, as they would have become with several weeks of delay, are succulent and easily separated with very little hemorrhage.

I have carefully tested this method and can report conscientiously that the danger of the double anæsthesia is not to be considered in comparison with the added factor of safety.

Also, that there is a decided shortening of the total duration of the operation.

In conclusion, permit me to call to your attention two valuable points in operative surgery: First, arrange the operation whenever you can so as to permit cessation of the work at any moment. Second, get through with the essential part of the operation early, so that if you must stop the patient will have been relieved.

THE EFFECT OF SCARLET RED, IN VARIOUS COMBINATIONS, UPON THE EPITHELIATION OF GRANULATING SURFACES.*

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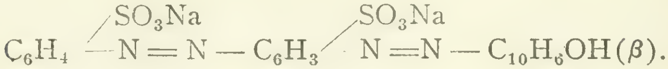
THIS paper has as its basis the observations made during the treatment of 60 cases with scarlet red.

Chemical Structure.—Scarlet red, or Biebrich's scarlet red, was discovered in 1882, and is an anilin dye which stains silk and wool a brilliant scarlet color. It is a disulphonic acid derivative, and the dye on the market is the sodium salt of the staining acid, and is in the form of a powder. It is made from diazoazobenzoldisulphonic acid and β-naphthol and has the formula,



$$C_6H_4\begin{array}{l}\diagup SO_3Na\\ -N=N-\end{array}C_6H_3\begin{array}{l}\diagup SO_3Na\\ \;N=N-\end{array}C_{10}H_6OH(\beta).$$

Experimental Use of Scarlet Red.—Fischer, of Bonn, in his paper on "Experimental Generation of Atypical Epithelial Proliferations, etc.," published in 1906, called attention to the fact that when a saturated solution of scarlet red in olive oil was injected subcutaneously, an inflammatory condition was produced, and there was also an increase of mitosis in the germinal layer of the skin, as well as in the hair follicles and skin glands. He was able to produce this proliferation only in the skin, and from this was led to believe that scarlet red acted as a specific attraxin upon the surface epithelium. He found that the new formation of epithelium caused by the injection of scarlet red oil, which very markedly resembled skin carcinoma, showed no tendency for independent after-growth, and kept up only as long as the injections were made. When these were discontinued the new formation retrograded and degenerated into epithelial pearly bodies. This suggested to him that it might be used therapeutically.

Helmholz, in 1907, was able to produce similar epithelial proliferations in the skin, and in addition succeeded in creating a like growth in the mouth and rectum. He thought that, with the technic as finally developed, he could get the same results in the stomach, intestines, etc. The positive results in the mucous membranes of the mouth and rectum would rule out the idea of Jores that the presence of hair follicles was necessary.

Helmholz found that there must be close contact between the scarlet red oil and the epithelium, in order that any reaction take place. He believed that scarlet red could hardly be claimed as a specific attraxin, but rather something that by interaction with the connective tissue produced a soil that was ready for epithelial development. He also showed that the cylindrical epithelium in these experimental tumors remained so only as long as it lined a lumen, and when it formed in masses it changed to the squamous type, and just as readily returned to the cylindrical type when lumina formed in the epithelial masses. This metaplasia showed how different the process was from carcinoma, in which the character of the cells remains constant.

Werner, in 1908, found that concentrated scarlet red oil injected into mice carcinomata stimulated the growth only while the injections were continued, and from his experiments came to the conclusion that the proliferation was not a chemotactic influence on the cells, but occurred through the irritation of the same.

The above brief mention of the action of scarlet red oil, when injected subcutaneously, will give an idea of the theories brought forth as to the cause of the epithelial proliferations. I shall not discuss their relative merits here, but will simply take up the clinical results obtained by the local application of scarlet red, in various combinations, on granulating wounds.

in order to hasten epitheliation. From the experimental work mentioned above, and from the results of the therapeutic action so far reported, it seemed perfectly safe to use scarlet red externally for therapeutic purposes, without danger of producing carcinoma. My own investigations have, so far, confirmed me in this belief.

The only literature on the therapeutic use of scarlet red is as follows: Schmieden was the first to apply Fischer's suggestion, and published a paper on "Epithelial Growth under the Effect of Scarlet Red" early in 1908. Kaehler, in May, 1908, and Krajca, in September of the same year, and also Cernezzi, in February, 1909, published enthusiastic articles on this subject, with modifications of Schmieden's technic. Wolfrum and Cords, in February, 1909, reported favorable results on corneal ulcers with scarlet red salve.

Being stimulated by these papers, and having an opportunity to treat and observe a number of granulating wounds in the Surgical Outpatient Department of the Johns Hopkins Hospital, I began a series of experiments with the scarlet red. A few of the cases thus treated were house cases in the Johns Hopkins Hospital and at the Union Protestant Infirmary, but the greater number were those in the Outpatient Department. These cases were not selected, and the wounds for the most part were very unsatisfactory to start with. Many were chronic ulcers of various varieties, belonging to the class of wounds upon which Schmieden stated the treatment with scarlet red was useless. A large number of these patients continued their daily occupations, and thus the factors of rest and regular attendance could not be counted on. In fact, a more severe test of a treatment could scarcely be applied.

The dye employed was that manufactured by the Badische Company of Ludwigshafen, Germany, which is sold in one pound cans, and is inexpensive. In the experiments, I have used 2, 4, 5, 8, 10, and 20 per cent. scarlet red ointments, with a simple vaseline base. As I have been unable to observe any especial antiseptic properties in scarlet red, I had the following antiseptic ointments of U. S. P. strength made up in vaseline, and containing 8 per cent. scarlet red; boric acid; zinc; iodoform; blue ointment; and an ointment consisting of one drachm balsam of Peru to one ounce of vaseline. On several occasions I have dusted small wounds with the pure powder.

The ointments were prepared by rubbing up the scarlet red with a small amount of olive or castor oil, until a smooth mass resulted, and then this mass was thoroughly mixed with the base. Sterilization of the ointment caused the color to become somewhat darker, but this change did not seem to affect the stimulating power of the preparation.

Technic.—Clean, healthy granulations should be bathed with boric acid solution and dried. Should the granulations be unhealthy, peroxide of hydrogen is used in addition before the boric acid solution. I have found it best not to use bichloride of mercury or other strong antiseptic solutions on the wound before treating it with the scarlet red. Free use of nitrate of silver stick is advisable to keep down exuberant granulations. The skin surrounding the defect should be anointed with some bland ointment up to within 1 cm. of the edge. Since this has been done the irritation complained of in some of the early cases has been, to a large extent, eliminated.

The ointment may be applied over the whole surface of the wound if it be small, or simply to the growing epithelial edges. Whichever method is chosen it is best to apply the ointment on perforated old linen, to which the granulations will not adhere, and which allows the escape of secretions and thus prevents maceration. When applied to the edges, the old linen should be used in narrow strips covered with a thin layer of the ointment. I prefer the old linen to the rubber protective advocated by Cernezzi, as it is less macerating.

Another very satisfactory method is to apply a thin coating of the scarlet red ointment to the wound edges with a camel's-hair brush, being sure that the edges are dry. Then either cover with strips of old linen, or expose to the air. This is especially useful in the partial graft cases and on small wounds as the ointment can thus be accurately placed and the amount regulated. The portions of the wound not covered by scarlet red may be dressed as seems best, or may simply be exposed to the air under a cage.

A light dressing of sterile gauze secured by a bandage completes the procedure. This dressing should be removed within forty-eight hours, twenty-four-hour intervals being preferable, and replaced by some bland ointment, such as zinc or boric acid ointment. After the same interval has elapsed the scarlet red dressing should be replaced. The importance of careful dressing is to be emphasized, as in some cases severe irritation has followed the improper application of the dressing. It is well to warn patients that the ointment may stain the dressing red, as several have returned much frightened, saying that the wound had been bleeding.

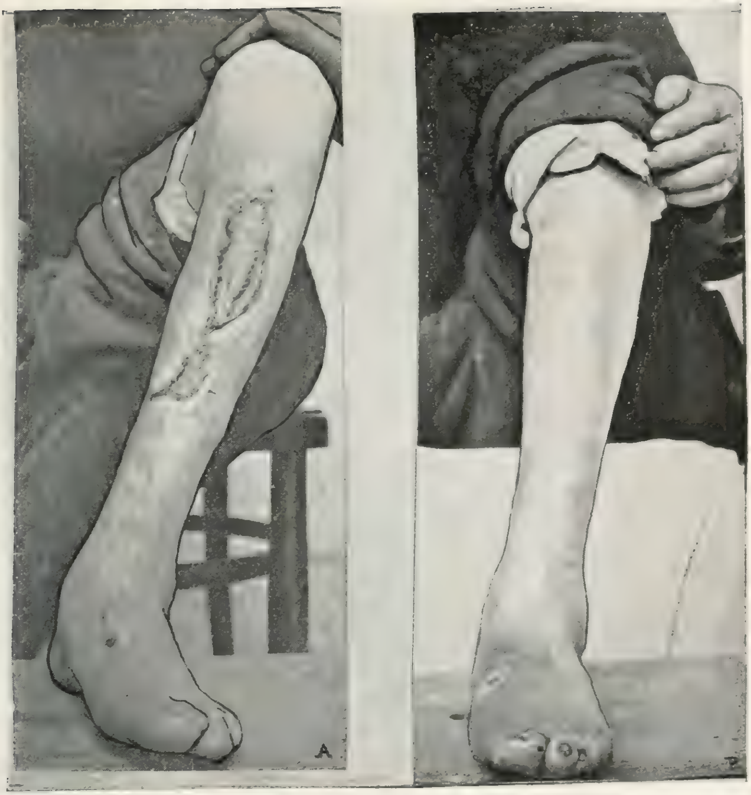
Cases Treated.—There were 60 cases treated, of whom 44 were males and 16 females. The youngest was 2 years old, and the oldest 76 years. White, 46; colored, 14. *Duration of the lesions,* a few days to 15 years.

The cases were grouped as follows:

Partial skin grafts,	7
Ulcer following operation for infection,	10
Ulcer following burn,	11
Traumatic ulcer,	10
Specific ulcer,	8
Varicose ulcer,	7
Ulcer following Cotting operation for ingrown toe nail,	3
Bedsore,	2
Miscellaneous ulcer,	2

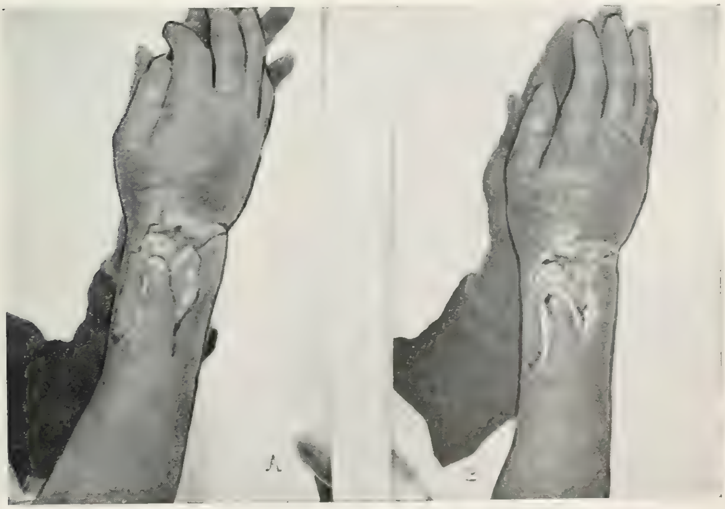
The general health of the patient seems to have some bearing on the stimulating effect of the scarlet red, which is distinctly less marked in nephritic and diabetic cases. The age, on the other hand, has little or no effect; for instance, the measured growth on one patient 76 years old was 3 mm. in 48 hours; and in another 67 years old, there was a growth of thick epithelium 4 mm. wide in 48 hours (Figs. 1 and 2). As we seldom have two lesions of exactly the same size on the same person, it is difficult to make an accurate comparison

FIG. 1.



Traumatic ulcers, 11 × 5 cm. and 5 × 2 cm. Age of patient, 76 years. Duration, 3 months. (*A*) Taken January 27, when treatment was begun. (*B*) Taken March 22.

FIG. 2.



Ulcer following operation for infection of forearm and wrist. Largest diameters 15 × 5 cm. (*A*) Taken January 27, when treatment was begun. (*B*) Taken January 29. The stimulation of the epithelial edges is well shown in this picture, and measures 4 mm.

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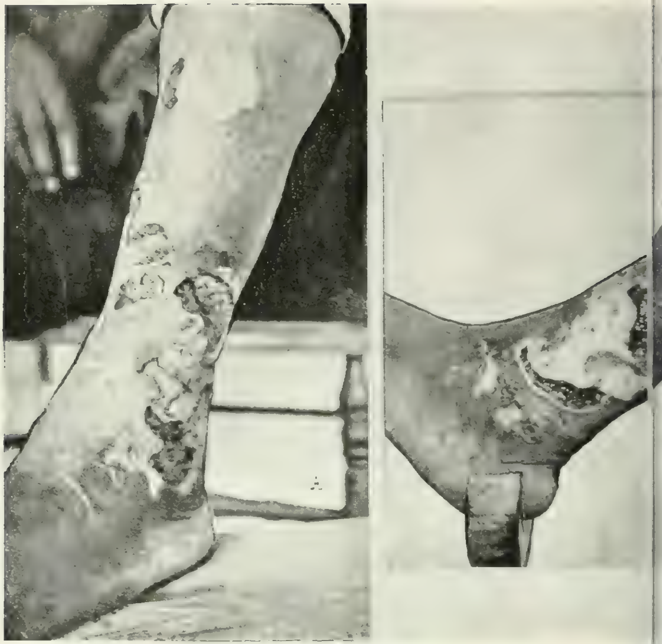

Multiple specific ulcers on outer side of leg of negro. Duration over one ye
when treatment was begun. (*B*) Taken December 9. (*C*) Taken Fe

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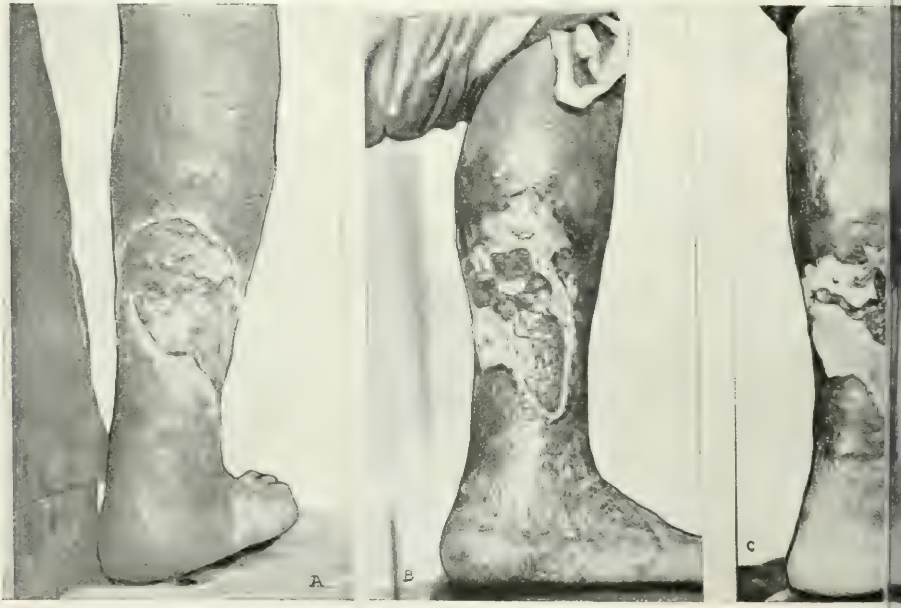
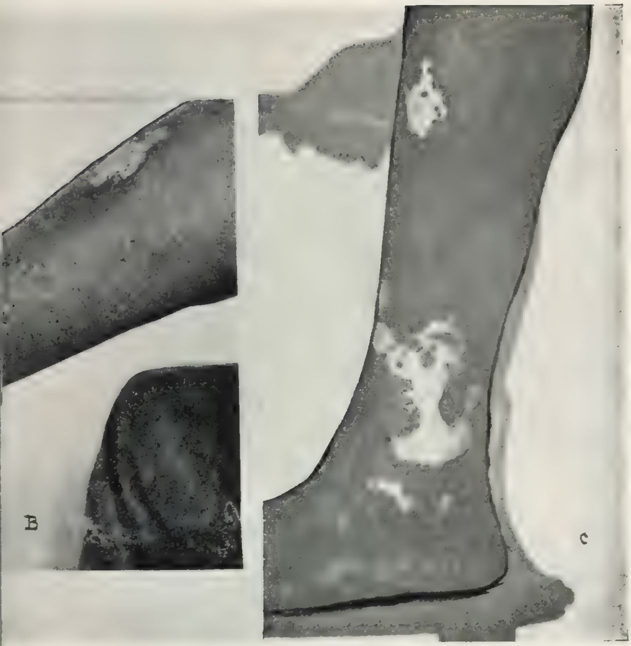
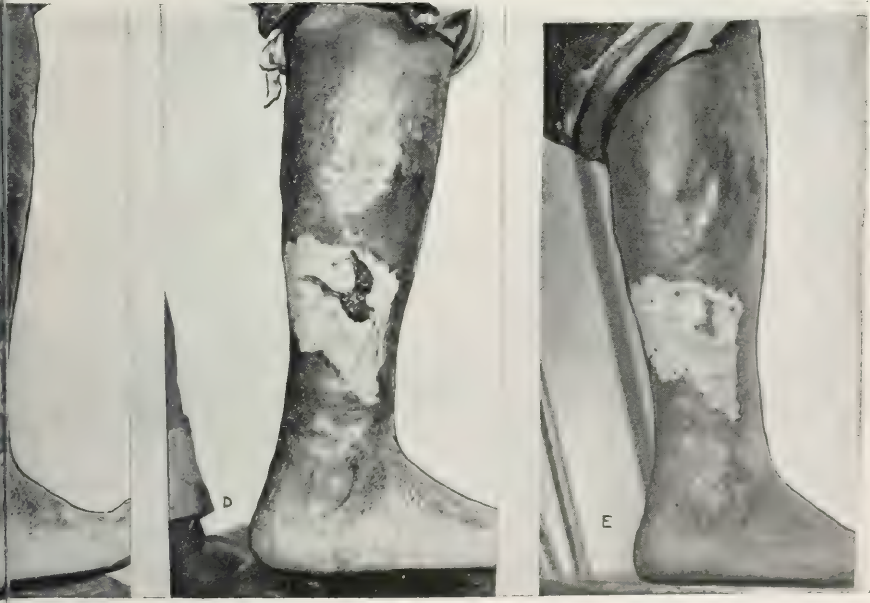


Varicose ulcer, 15 × 9 cm. Duration several months. (*A*) Taken October 16, 1908, when treatment wa
February 10. *A* to *C* show the stimulation of the lower left-hand po

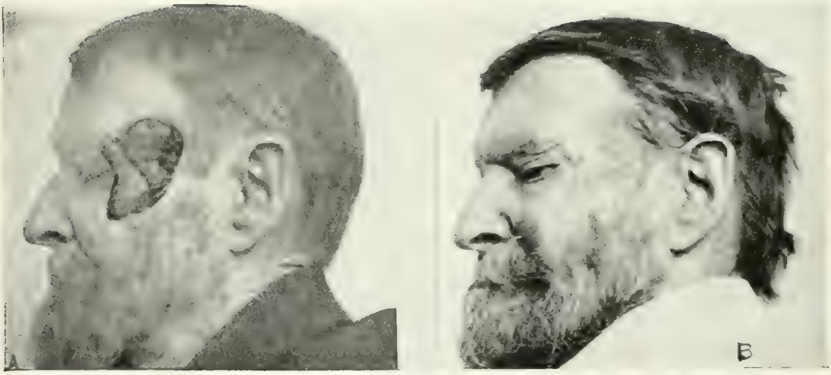


Ulcers, 4 × 2 cm., 6 × 4 cm., 8 3 cm. (*A*) Taken November 25, 1908.
ry 4, 1909. Note return of pigmentation in newly formed skin (*C*).



gun. (*B*) Taken November 18. (*C*) Taken December 18. (*D*) Taken January 2, 1909. (*E*) Taken
n of the skin edge. Note return of pigment in new pink skin in *E*.

FIG. 5.



Ulcer following excision of epithelioma, 6 × 5.5 cm. Bone exposed. (*A*) Taken January 11, when treatment was begun. (*B*) Taken March 17. Difficult to make out edges of the scar.

between the rapidity of healing of a wound treated with scarlet red and one treated with the ordinary methods. However, on one patient there was an ulcer 3.5 × 3 cm. on each leg, and the one treated with scarlet red healed three weeks before the other, which was treated in the usual way. The difference in the appearance of the newly healed area was very marked, that following the scarlet red being thick, firm, and so much like the normal skin that it was difficult to make out the original outline of the ulcer, while the usual sharply defined scar marked the location of the other ulcer. In many cases there is undoubtedly a very marked stimulation of the epithelial growth, and, taking the results as a whole, while personal supervision in this series in connection with careful dressing is a factor which must be considered, one would hardly feel justified in attributing the success of the treatment entirely to this supervision.

The rapidly growing epithelium is thick and at first a bluish-red with an opalescent spreading edge. Venules of considerable size can be seen close to the surface. The color and the enlarged vessels soon disappear, however, and the newly formed tissue rapidly assumes the color and characteristics of the normal skin. A section through an area thus healed shows practically normal skin. As a rule, after a short time this skin becomes freely movable over the underlying tissues.

In several instances the patient did not return for from 5 to 16 days after dressing with scarlet red, and it was noted in two of these cases that where the granulations had been exuberant on small ulcers, a cone-shaped mass of epithelium covered these granulations. This projection soon disappeared and the epithelium assumed the level of the surrounding skin. No apparent bad effect resulted from the prolonged exposure to scarlet red in these cases, except that a grayish membrane formed over the granulations, which could be stripped off and the healthy granulations exposed. It is needless to say that there was no irritation in this group of cases. The grayish membrane over the portion of the granulations covered with scarlet red will often form within 48 hours, and can be easily lifted off.

The method of pigmentation of the newly formed pink skin on negroes is interesting. Within a short time the sharply defined edges of the normal skin become wavy, and streaks of pigment project from it (Figs. 3 and 4). Here and there in the pink skin isolated patches of pigment appear, some of which are several centimetres from the pigmented skin edge. This seems to show that the pigment is derived from the deeper tissues, as well as from the skin edge. The pigment spreads from these patches also, and the entire area becomes dusky and later assumes the color of the neighboring skin.

The sensation of the newly formed skin begins at the margins and gradually spreads towards the centre. This is similar to what occurs in skin grafts, the nerve supply coming from the edges of the wound and not from the underlying tissues.

On those wounds which heal and then break down, because of the unstable condition of the epithelium, scarlet red has been useful; for example, a superficial ulcer following a burn on the front of the ankle and entire dorsum of the foot had nearly healed several times, and then completely broken down again. Treatment with scarlet red ointment was begun on December 26, 1908, and the healing was complete and all dressings were omitted on January 8, 1909, since which time the patient has had no further trouble, as the wound is covered with thick stable epithelium.

Scarlet red should not be used on burns until the irritation has disappeared, and the granulations are well established.

The exact strength and combination of the ointment to be used on different types of wounds can hardly be dogmatically stated, as experience is necessary for this knowledge. However a few general observations may be of advantage. The 8 per cent. ointment is used unless especially contraindicated. In some cases which were sluggish to the 8 per cent., the 20 per cent. ointment has caused rapid stimulation of the edges. I should not advise the constant use of the 20 per cent. strength, as on several occasions it has proved too irritating in spite of all precautions. It is of value now and then, although its action should be carefully watched.

On several wounds which were nearly closed, the pure scarlet red powder was dusted on the uncovered area, after protecting the surrounding skin. It had a marked drying effect and caused no irritation.

When the wounds are covered with unhealthy granulations and the discharge is profuse and foul smelling, I have found the scarlet red in iodoform ointment, or balsam of Peru, or blue ointment very efficacious in cleaning up the granulations and at the same time stimulating the epithelial growth.

As an example of the unfavorable type of wounds treated, I will mention an extensive multiple leg ulcer of five years' standing, which was covered with maggots when the rags with which it was wrapped were removed. This was cleaned up and dressed with scarlet red and within 48 hours there was a definite stimulation of the epithelial edges, and uneventful healing later. It is interesting that this patient came to the Dispensary because he had mashed the tip of his little finger, and not for the leg condition, which he had been taking care of at home.

A number of large specific ulcers having a duration of from three months to five years, which had not responded to constitutional or local treatment, were stimulated markedly by scarlet red. Although they were among the most unfavorable-looking ulcers, the healing was prompt and lasting. In the specific cases constitutional treatment was of course continued. Several of these ulcers were very sensitive, and the patients volunteered the statement when returning for dressing that the "red salve" gave them more comfort than any dressing they had ever had. This seems a curious fact, inasmuch as scarlet red had an irritating action on some other cases, and caused pain and discomfort. Scarlet red in blue ointment is especially useful in treating specific ulcers.

There is a difference in the degree of stimulation caused by scarlet red on the epithelial edges of the same wound at different times. I have also noted that in several cases one portion of the growing edge was markedly stimulated while the remaining portions were only moderately so.

The skin formed under scarlet red seems to fill the place of the missing skin, somewhat like a whole-thickness graft, and in only one case has there been any tendency towards cicatricial contraction. This case, a burn of the neck and chest, was treated in the hospital by the usual methods for some time before scarlet red was started. Several weeks after healing the patient returned with a small contracted band of scar tissue on the left side of the neck. She was advised massage, and told to return if the condition continued.

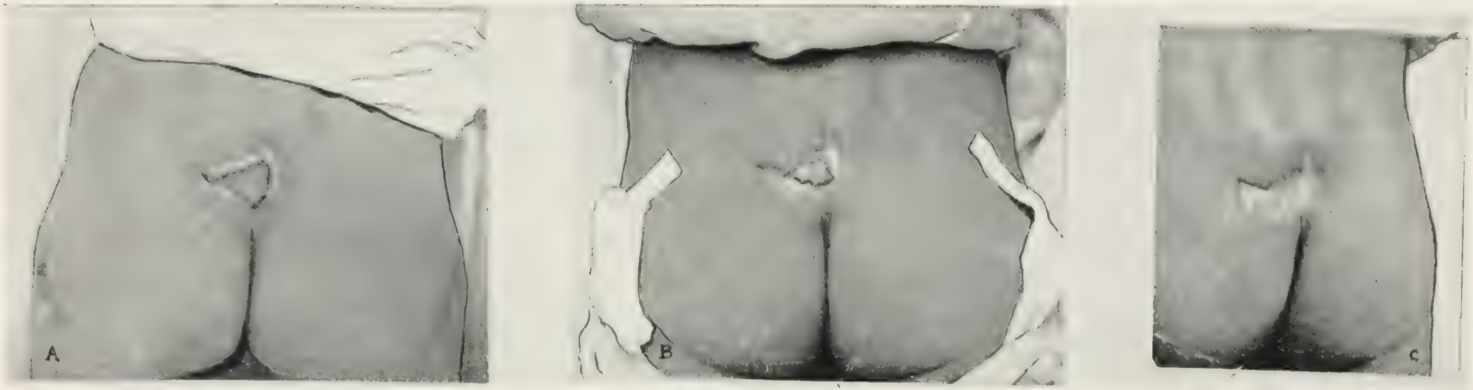
Several varicose ulcers were treated with scarlet red without a pressure bandage, in order to test the efficacy of the healing, and there was no diminution noted in its rapidity or character.

Ulcers following the Cotting operation for ingrown toenail are usually sluggish and heal slowly, but with scarlet red the healing is materially hastened.

In an ulcer following the excision of an epithelioma of the face, there was a recurrence in the lower angle of the wound three weeks after operation. The ulcer had been treated once with scarlet red, only two days before the recurrence was noted, so I do not consider that the scarlet red was in any way responsible for the recurrence (Fig. 5).

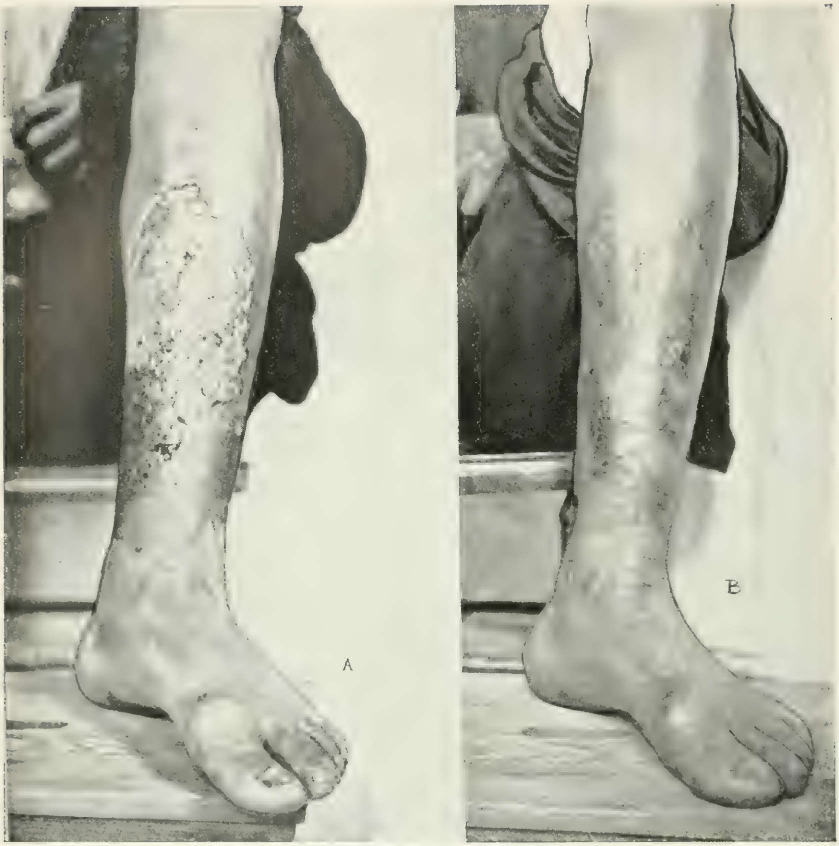
I have been able to try the effect of scarlet red on an autodermic and isodermic partial Thiersch and whole-thickness grafts, and also on zöodermic (dog) grafts. All of the seven cases which were grafted had very extensive lesions, and several partial grafts were placed on each of these at different times. The wound edges and also the edges of all these types of grafts were markedly stimulated. Scarlet red, 8 per cent., if applied to the surface of a Thiersch graft within four days after transplantation, causes maceration of the surface. In order to avoid this I find it advisable to apply the scarlet red, in from 4 per cent. to 8 per cent. strength, to the edges of the graft alone, and not until ten days have elapsed. Only the edges of whole-thickness grafts should be covered with scarlet

FIG. 6.

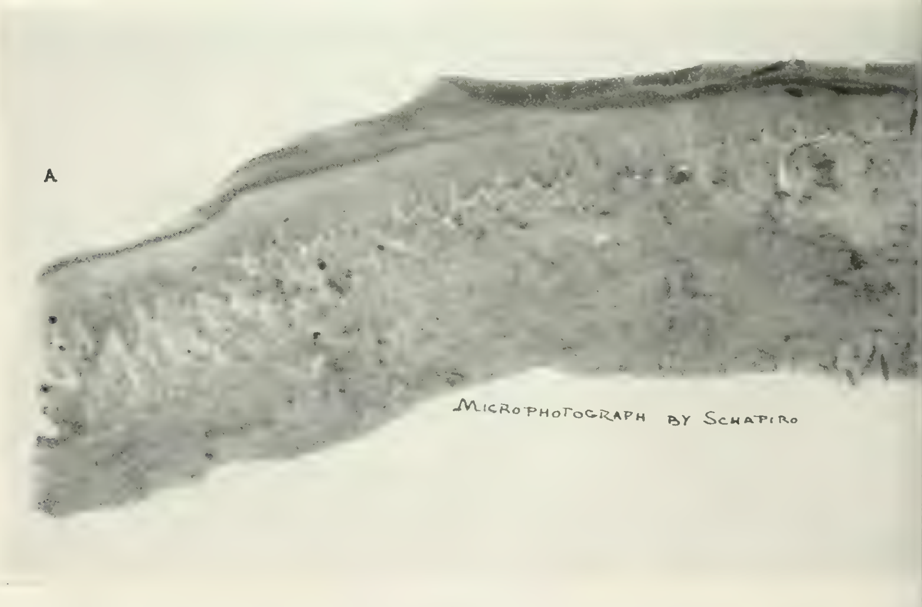


Bedsore following typhoid, 3 × 5 cm. Duration several months. (A) Taken November 6, when treatment was begun. (B) Taken November 18. (C) Taken December 7.

FIG. 7.

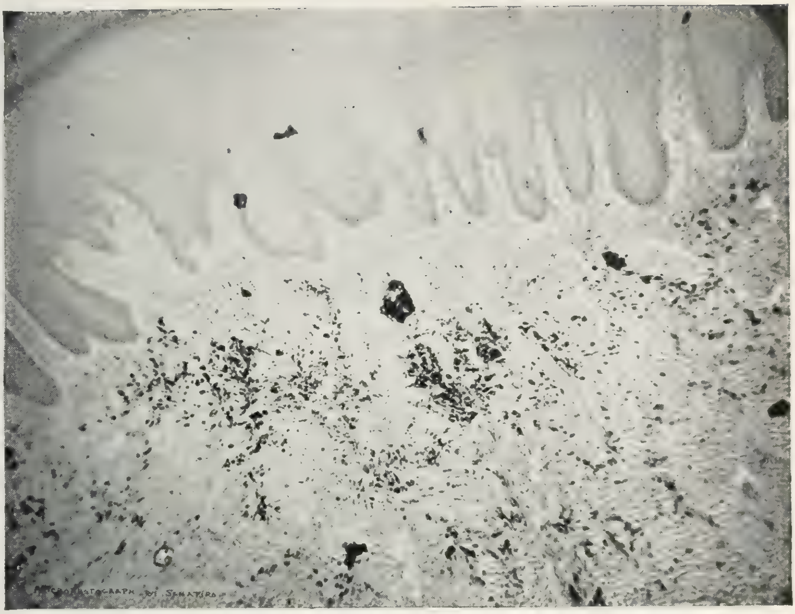


Ulcer following injury, with subsequent deep infection. (*A*) Taken December 4, when treatment was begun. (*B*) Taken December 14.



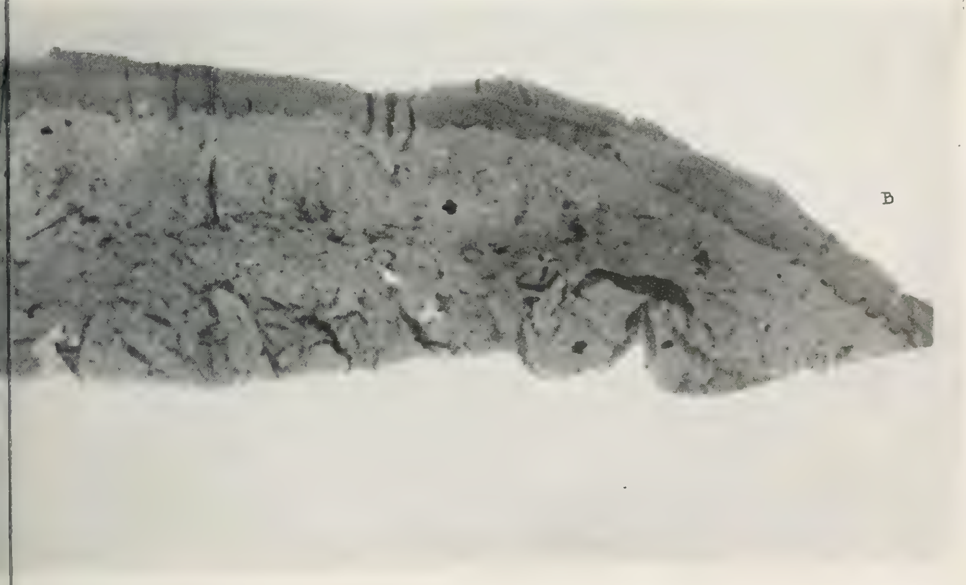
Section of negro skin, formed under Scarlet Red treatment, on a chronic varicose ulcer of the leg. The
pigment in the deep layers of the stratum Malpighii. At *B* the papillary formation is not especially noticeab
ary formation becomes more marked. All the layers of the epidermis become much thicker, and under high p

FIG. 8.



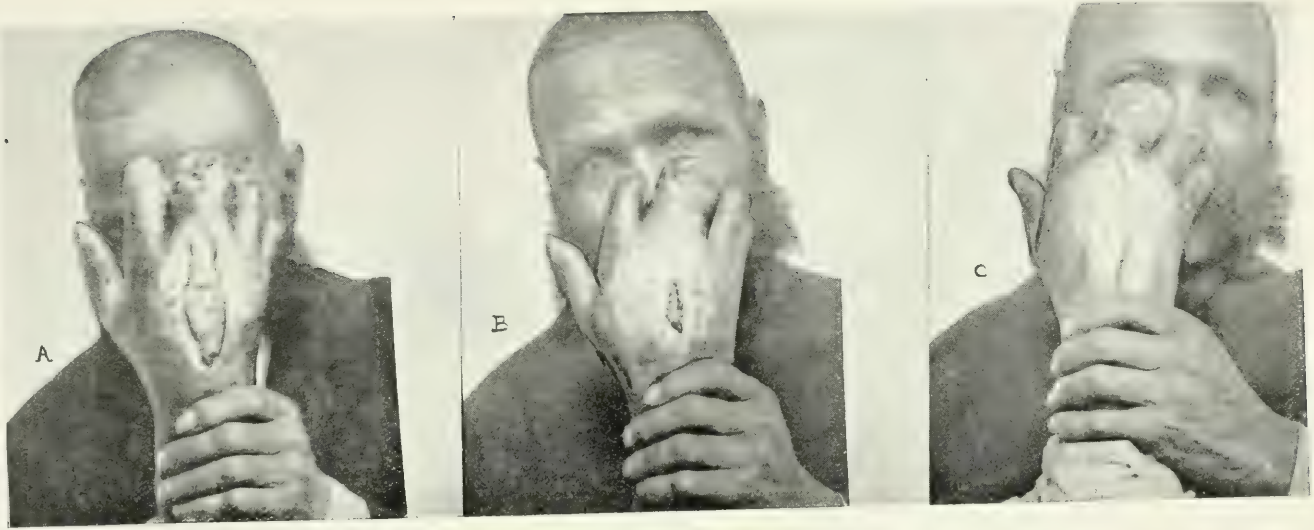
A small portion of Fig. 9 under higher magnification. Note the papillary formation and the thickness of the stratum Malpighii. The masses of pigment cells in the deeper layers of the skin are interesting from the fact that the newly formed skin is pink and shows no pigmentation, while in certain portions of the section, where it passes through an isolated pigmented spot in the pink skin, there seems to be a definite relationship between the pigment in the deeper layers and that in the cells of the stratum Malpighii.

9.



A is 2 mm. from the growing epithelial edge. The end *B* is a portion of the normal surrounding skin and shows d the stratum corneum and Malpighii are about normal thickness. As we follow the surface toward *A*, the papil- intense cell division can be seen

FIG. 10.



Ulcer following operation for infection, 9 × 3 cm. Duration, 1 month. (*A*) Taken December 30, 1908, when treatment was begun. (*B*) Taken January 8, 1909. (*C*) Taken January 15. Measure on final healing, 6.5 × 1.5 cm red, unless the superficial layers are cast off, in which case the whole surface of the graft should be covered, as it will hasten the "topping" of the graft with epithelium.

Wolfrum and Cords report favorable results with 5 per cent. scarlet red ointment on corneal ulcers.

My experience with scarlet red on mucous membranes has been confined to pieces of vaginal mucosa transplanted to granulating wounds. The edges of these grafts were stimulated; also, the defect left by the removal of sections for examination healed under scarlet red very rapidly. From the above experience I have no doubt but that this method of treatment can be utilized with advantage on mucous membranes which can be kept reasonably dry.

It is an interesting fact that the scarlet red is absorbed and then excreted by the kidneys. This has been noted in a number of cases; for example, a large ulcer of the chest, following a burn, was dressed with scarlet red, 8 per cent., at 1.30 P.M. December 13, 1908. The urine voided at 2.10 P.M. was amber clear; at the next voiding at 9.30 P.M. it was a bright scarlet; December 14, at 2 A.M., still a bright scarlet; at 8.10 A.M. it was a pale red; at 11.25 A.M. still a pale red; at 1.30 P.M. the scarlet red was removed and the wound was dressed and irrigated. At 2.15 P.M. the urine was a reddish amber; and so on until 8.30 A.M., December 15, when it was a pale pinkish color; after this the urine resumed its normal amber color. There is no undue stimulation of urinary secretion, and except for the color the constituents of the urine are unchanged. The other excretions were apparently unaffected.

There was severe irritation in ten cases, eight of which were not permanently helped by the treatment, although there was stimulation of the epithelial growth in all but two cases. Most of these cases were those treated early in the series, and since better technic has been employed no severe irritation has occurred. However, in sixteen other cases there was a slight reddening of the surrounding skin accompanied by a burning sensation at some time during the treatment, although this in no way interfered with the ultimate result.

In several instances scarlet red had to be discontinued on account of the pain and irritation caused by it. This was especially noticeable in women and young children. In the case of a child two years old, with an ulcer following a burn of the axilla, the irritation of 5 per cent. scarlet red ointment was very marked. Following a second application of the ointment there was a sharp attack of erysipelas. Cultures from the ointment were negative, and as there had been no case of erysipelas in the hospital for some time it is likely that the irritation produced a favorable condition for the infection.

In a case of varicose ulcer of which the duration was ten years, and where the skin was particularly sensitive to scarlet red, there was a definite phlebitis of several veins in the neighborhood of the ulcer after the third dressing with scarlet red, and it seems probable that the irritation caused by the scarlet red might have extended into some of the superficial varicose veins. This patient became very ill and was admitted to the hospital. He ran a high temperature for about ten days, which was suspected to be due to typhoid infection, but this was not proved, and about three weeks later he was discharged from the hospital, the phlebitis having cleared up perfectly.

In a tuberculous ulcer of the groin of eight months' duration, measuring 8 x 10 cm. and having undermined edges, scarlet red was tried and very markedly stimulated the epithelial growth. It was quite remarkable that the new thick epithelium started beneath the undermined edges, and for a time these edges overlapped the new epithelium slightly, but were finally absorbed. This ulcer healed rapidly with firm healthy skin until 1.5 x 2.5 cm. remained uncovored, then suddenly without any apparent cause the ulceration began again here and there on the edges and in the new skin. On the continuance of the same treatment the ulcer finally healed completely, and as yet shows no tendency to break down.

Where tight pressure bandages are applied over scarlet red, there is more likelihood of irritation. There have been several cases in which there was marked stimulation of the epithelial edges at the beginning of the treatment, but later just as marked deterioration. This was the case especially when the attendance of the patient was irregular, and in such instances the treatment with scarlet red was discontinued.

In one case where a patient with a varicose ulcer stayed away from the Dispensary for five days with the scarlet red dressing, the irritation of the surrounding skin was so intense that a breakdown was feared. This fortunately did not occur.

The skin over old scar tissue is apparently much more easily irritated than ordinary skin. The stability, thickness, and normal appearance of the healing under scarlet red is noteworthy, and even if the healing in some few instances is no more rapid than that under the ordinary methods, these advantages would seem to make it worth while (Figs. 6, 7, 8, 9, and 10).

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CHLOROMA OF THE JAWS.*

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CHLOROMA is such a rare condition that the following case should be of some interest.

M. B., an Englishwoman aged 38, who was married and had three children, and had resided in Canada during the previous three years, came to the surgical out-patient department of the Toronto General Hospital on February 12, 1909, where she was seen by Dr. W. Warner Jones.

About January 5, 1909, she suffered from violent neuralgic pains over the temporal region, cheek and upper jaw on the left side, and then first noticed a swelling of the gum of the upper jaw in the region of the first bicuspid tooth of the left side. A day or two later she noticed a similar swelling at a corresponding point on the opposite side, and simultaneously a swelling made its appearance around the first bicuspid of the lower jaw on the left side. Within a day or two the pain subsided, but the swelling continued to increase.

February 12. On examination a marked swelling of the gums is seen involving both jaws on the lingual and buccal aspects, except on the right side below, where the teeth are absent but for one or two roots. There are swellings under the jaw on both sides involving the sublingual and submaxillary lymphatic glands. The glands are fairly movable and not tender to touch. No other glands enlarged in the neck. The skin is swarthy but no pigmentation. The breath is very foul. The eyes are large and prominent, but she says they have always been so. Her vision is good, and there is no squint and no exophthalmos. The teeth are all in line and not loose. The swelling of the gums is very marked, spreading between the teeth, convoluted, dark purplish

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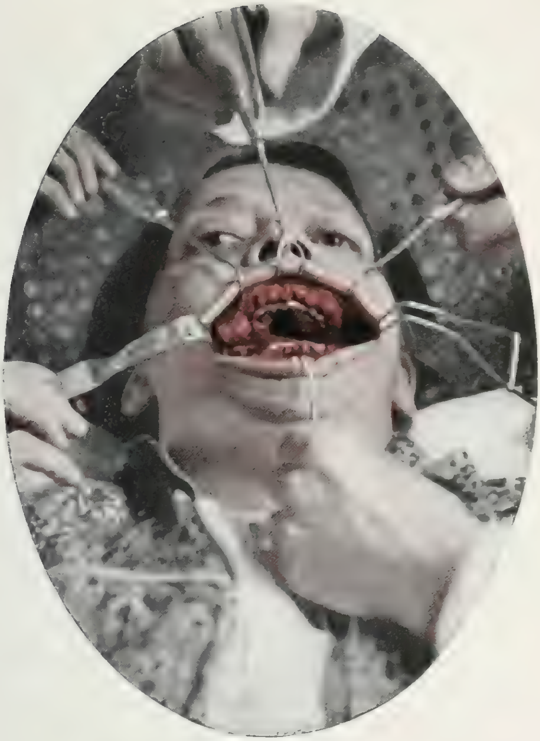
* Read before the Surgical Section of the International Medical Congress, Budapest, August 30, 1909.

FIG. 1.



The growth in connection with the jaws.

red in color, covered with epithelium, firm to touch, and not bleeding readily. The tonsils not enlarged. Temperature 99.6.

February 16: There is now ulceration and sloughing over the first right molar above. A piece was cut out for examination, and the pathologist reported that it was probably a lymphosarcoma. A blood smear was made and stained, and showed a slight increase in the white cells. A differential count showed: Polymorphonuclear neutrophiles, 42 per cent.; small mononuclear lymphocytes, 12 per cent.; large mononuclear lymphocytes, 41 per cent.; eosinophiles, 5 per cent. The blood platelets were much decreased.

About three weeks later, March 8, a firm ridge about the size of a whip cord could be seen, running all round the jaws above and below, just at the junction of the cheek with the gums. The breath was very foul and there were one or two sloughing areas. Some of the teeth were loose. The pulse was rapid and the temperature was 102°.

She entered the hospital on March 12, under my care, and for the next ten days had a typical septic temperature, running from 100° to 104°, while the pulse rate varied from 110 to 140. The swelling on the left side of the neck rapidly increased in size, as also did the growth in connection with the gums. The breath was very offensive, there was much salivation and she was going down hill very rapidly. Pus was exuding from around the teeth and gums; it was thought that absorption of this pus was responsible for her temperature.

At the urgent request of her friends and the family physician an operation was undertaken, with the object of not only removing the growth but of getting rid of the septic condition around the growth and teeth and stopping absorption. She survived the operation only a few hours—dying March 23, 1909.

Pathological Report, by O. R. Mabee, M.D., Assistant Pathologist to the Toronto General Hospital; Demonstrator in Pathology, University of Toronto.—The following report is based upon the examination of tissue removed at operation and upon the autopsy findings. The tissue removed at operation consists of several irregular convoluted masses purplish grey in color, and several molar teeth, to some of which are adherent masses of similar tissue. This tissue is fairly firm in consistence and its surface smooth except for a few small superficial ulcerations. On section it is light greenish grey in color.

Autopsy, March 24, 1909.—The permission for autopsy was limited to the examination of the organs of the body. Body is that of a well-developed and well-nourished adult white female. The pupils measure five millimetres and are equal. There is no exophthalmos. The cervical glands are enlarged on both sides. The axillary and inguinal glands are palpable.

Peritoneal Cavity.—Its surfaces are smooth and glistening throughout. The retroperitoneal and lumbar glands are moderately enlarged, varying in size from 0.5 to 2 centimetres in length. On section they are moderately firm and greyish in color. The mesenteric nodes are normal. There are several pin-point hæmorrhagic areas scattered throughout the visceral peritoneum.

Pleural Cavities.—Their surfaces are smooth and glistening throughout.

Pericardial cavity contains about 25 cm. of clear fluid. Its surfaces are smooth and glistening throughout.

Heart.—Weight 280 Gm. The myocardium is fairly firm in consistence and reddish brown in color. The endocardium and heart valves are normal. Coronaries normal.

Lungs.—Crepitation is present throughout. On section they are generally salmon-pink in color, irregularly mottled by black coal pigment. The bronchi and bronchioles contain a moderate amount of frothy blood. Bronchial nodes—normal in size and black in color.

Spleen.—Weight 165 Gm. Its capsule is smooth. On section it is reddish grey in color The malpighian bodies and trabeculæ are normal. No pulp on scraping.

Gastro-intestinal.—Normal. Pancreas—normal.

Liver.—Weight 1600 Gm. Its capsule is smooth. On section it is reddish brown in color and fairly firm in consistence. The lobules are easily visible. Gall-bladder and ducts are normal.

Kidneys.—Weight 320 Gm. The capsule strips easily and leaves a smooth surface. On section the cortex averages 5 mm. and is greyish white in color. The glomeruli are visible as glistening dots. The pyramids, pelvis, and ureters are normal. Adrenals—normal. Bladder—normal.

Genital Organs.—External genitalia, normal.

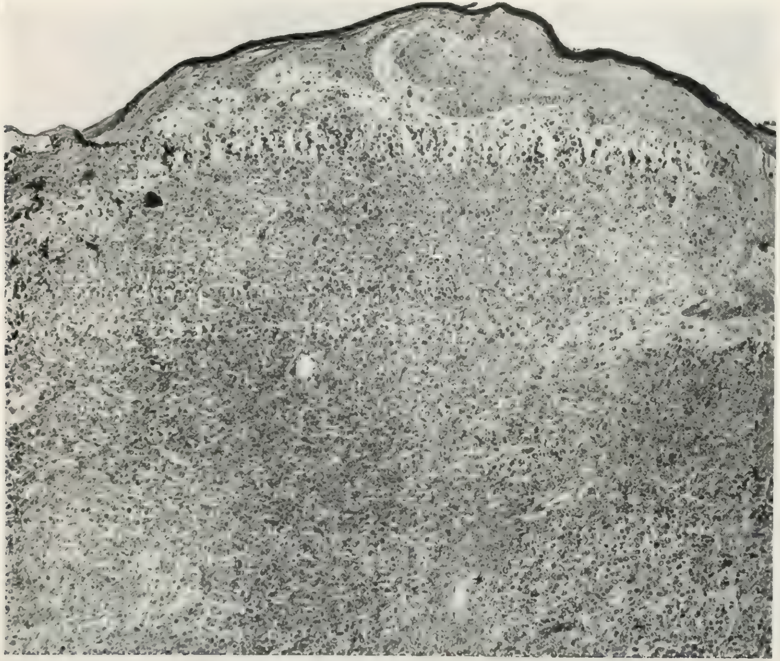
Uterus is slightly enlarged. On section its mucous membrane is deep red and has a small amount of clotted blood adherent to it.

Ovaries.—Both are somewhat enlarged. On section the left is moderately firm in consistency and greyish white in color. The right on section contains several small cysts.

Fallopian Tubes.—Normal. Aorta—normal.

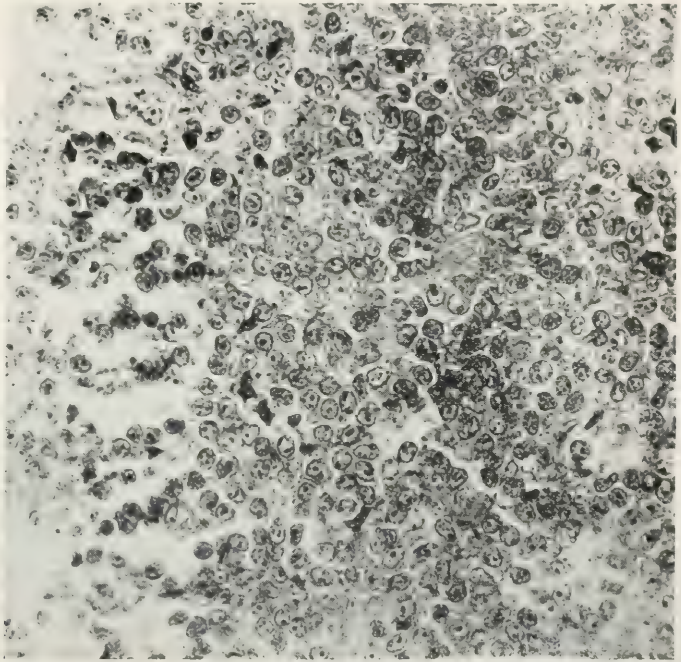
Organs of Neck.—Tongue—normal. Œsophagus—normal. Trachea—contains a small amount of bloody frothy material. Larynx—negative. The posterior and anterior axillary glands on both sides are enlarged. The largest measures 4 x 2 x 1 cm., being situated near the angle of the right inferior maxillary bone. They are discreet, gradually becoming smaller in the lower part of the neck, the supraclavicular glands being about normal in size. On section they are softer in consistence than normal

FIG. 2.



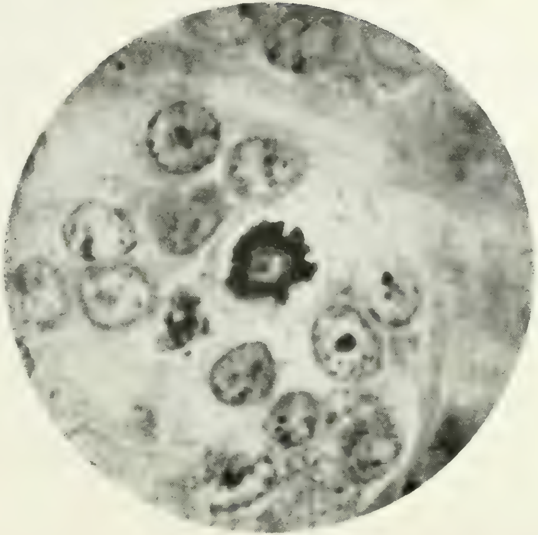
Low-power field through gingival tissue.

FIG. 3.



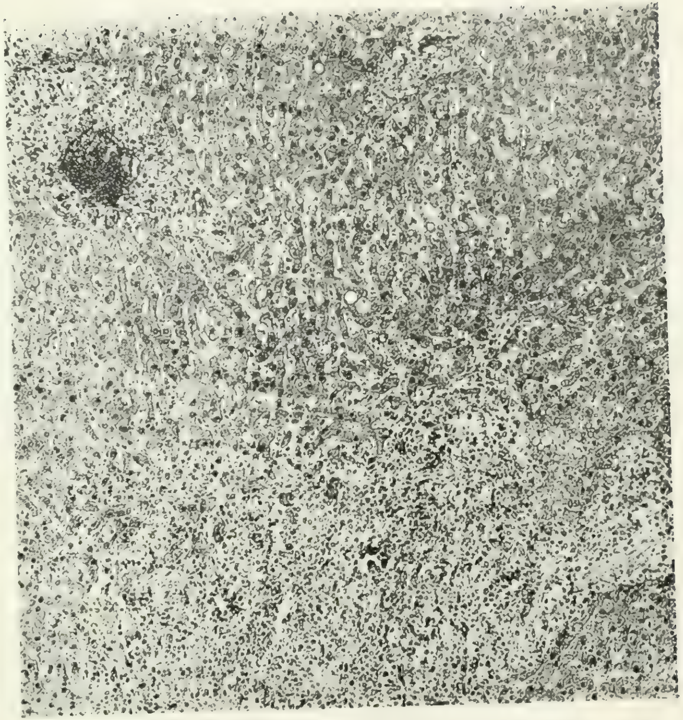
Low-power field (425 diameters) through gingival tissue, to show cellular character and scant stroma.

Fig. 4.



Cells (1500 diameters) showing cell structure and mitotic figure.

Fig. 5



Low-power field of liver showing leukæmic infiltration.

and the larger ones are a diffuse apple-green color. The axillary and superior mediastinal glands are apparently normal on section. The anterior portion of the superior maxillary bone is removed with following teeth *in situ:* middle incisors, lateral incisors, both canine, and the first bicuspid on the left side.

The portion of the alveolar process removed extends 2 cm. beyond the right canine and 1 cm. to left of biscuspid and shows cavities corresponding to teeth removed. The gums surrounding this have been removed and the bone is covered by blood clot. On removing this clot, a greenish grey, moderately firm mass of tissue is seen invading the alveolar process and extending upward into the antrum of Highmore on both sides. This tissue also extends along the inner margin of the alveolar process behind the teeth and onto the hard palate. The appearance of the inferior maxillary bone generally resembles the superior. The tonsils are both enlarged and on section are the same pale greenish grey color.

Bone Marrow.—Bodies of dorsal vertebræ show a reddish grey marrow. There is no evidence of chloromatous infiltration.

Anatomical Diagnoses.—Primary chloroma of superior maxillary bone; secondary chloroma of gums, palate, tonsils and cervical, posterior mediastinal, retroperitoneal and lumbar lymph nodes; cystic ovary; enlarged liver.

Bacteriological Findings.—Ærobic cultures made from the heart's blood were sterile.

Histological Findings.—Tissues were preserved in formalin, and in Zenker's fluid for histological findings.

Gingival Tissues.—Sections (Figs. 2, 3 and 4) through this show numerous large round cells infiltrating the mucous membrane, submucous and periosteal tissues. In the dense connective tissue of the periosteum the cells are often arranged in rows lying between and parallel to its fibres. In the submucous tissue they occur in solid masses, there being little supporting stroma. In some places the epidermis is absent and there are superficial ulcerations. In other places the epidermis is invaded by small groups of these cells (Fig. 2).

The invading cells (Fig. 3) are fairly uniform in size and mostly of the large mononuclear non-granular type. Stained by eosin and methylene blue, their nuclei are slightly larger than a red blood-cell. They are oval or round in shape, rich in chromatin granules, which are mostly situated in their periphery and they have a distinct nucleolus. They are surrounded by a small amount of cytoplasm which stains more faintly with the blue than the nuclei. The cell outline is indistinct. Mitoses (Fig. 5) are quite frequent, being more numerous in some fields than others. There is also evidence of amitoses, but the former are most frequent. The small rim of cytoplasm surrounding the nucleus is generally free from granules, but in a few, eosinophilic granules are sometimes present. There is an occasional larger cell with eccentric nucleus which contains eosinophilic granules that are irregular in size and shape. The cytoplasm of the latter cells is often vacuolated and they vary in size, being two to three times as large as the large mononuclear type. Sections of tissue fixed in formalin and examined unstained show an occasional cell which contains highly refractive shining granules. In other areas there is a distinct pale greenish color to the cells in which no granules are present. None of the granules above mentioned stain by Scharlach red, and in none of the sections fixed in Zenker's fluid is there any evidence of deposition of pigment.

Superior Maxillary Bone.—Sections through the alveolar process, antrum of Highmore, and bicuspid teeth were decalcified in 5 per cent. nitric acid. The teeth are apparently normal and there is no invasion of the peridental membrane. The alveolar process and antrum are invaded by large numbers of cells similar in morphology to those invading the gums, and in sections to which the gingival tissues is adherent they are directly continuous with one another. The bone-marrow of the superior maxillary bone is so replaced by cells of the large lymphocyte type that practically no normal marrow is present in the sections examined. There are, however, areas where a few eosinophiles and neutrophiles are present, but their morphology is similar to those above. In sections where the teeth are *in situ* there is infiltration of their sockets and the surrounding cancellous bone, which is considerably rarefied.

Lymph Glands.—In the greenish colored cervical glands where the green is darker than in gingival tissue, the invasion by cells of the large lymphocyte type is so marked that the normal structure of the gland is destroyed. The study of these cells shows them to be of the same type as described above, an occasional one having eosinophilic granules. There are, however, larger numbers of cells with vacuoles, eccentric nuclei and eosinophilic granules which are irregular in size and shape. These latter cells are similar to those noted above in the gingival tissue, and the study of unstained sections shows that areas in which these are most numerous correspond with the areas in which most of the green pigment is present. The mediastinal, retroperitoneal and lumbar glands show varying degrees of invasion by the large lymphocyte type of cell. In the majority of glands there is no evidence of invasion of the capsule. In a few of the larger, however, there is an infiltration of the capsule.

Heart.—Negative.

Lung.—There is marked congestion of blood-vessels throughout. A few alveoli are filled with red blood corpuscles. There is a slight increase in the large mononuclear lymphocytes within the vessels.

Spleen.—It is slightly congested. The large mononuclear lymphocytes are moderately increased throughout, an occasional mitosis being present in them. The eosinophiles are increased to two or three times their number. The blood within the vessels shows an increase in the large mononuclear lymphocytes.

Liver.—There are small foci of leukæmic infiltration (Fig. 5) closely related to the blood-vessels, whose walls sometimes contain a few similar cells. The sinusoids also contain fairly large numbers of these cells. The infiltration varies in degree in different parts of the organ. The cells in type generally resemble those in the glands and gingival tissue. A few are multinucleated and there is an occasional cell with eosinophilic granules which is larger than the large mononuclear type and which shows degenerative changes. There is evidence of division of these cells both within the capillaries and in the leukæmic foci. An occasional liver cell is vacuolated.

Adrenal.—Negative.

Blood-Vessels.—There is a slight increase of white cells in the blood within the vessels throughout. About 50 per cent. of these are of the large mononuclear nongranular type. Only an occasional cell has eosinophilic granules. *Aorta.*—Negative.

Tonsils.—They also show infiltration with cells of the large mononuclear type, varying in degree in different parts. In some of the crypts there is a small amount of acute inflammatory exudate.

Summary and Conclusions.—From the above findings it is apparent that this is a case of chloroma. The study of sections of the superior maxillary bone would indicate that the primary condition must be regarded as a tumor originating in this. The secondary infiltration of the periosteum, gingival tissue, lymph glands, liver, kidneys, etc., is proof of its neoplastic nature. The infiltration of the liver and kidneys is similar to that seen in the acute lymphatic leukæmias of the large cell type. The proliferation of cells takes places by both mitosis and amitosis. There is evidence of a leukæmic condition of the blood. From the fact that in this case most of the cells are well differentiated into the large mononuclear nongranular type, and that only a few contain eosinophilic granules, it does not seem possible, as Warthin suggests, that these granules account for the greenish color of the tumor. The occurrence of foci of degenerating cells in the chloromatous tissue whose chromatin shows marked chromatolysis may account for this greenish pigment.

The microphotographs were made by Mr. L. S. Brown, at the Massachusetts General Hospital, for whose careful work I wish to express my thanks.

LITERATURE.

In 1904, Dock of Ann Arbor gave a résumé of the cases of chloroma which had been published up to that date. Since 1893 there had been 21 cases, and prior to that 17 cases, making in all 38 cases. On examining the literature of the subject I have been able to find 16 cases which have been reported since 1904, bringing the total number of cases reported up to the present time to 54. The average age is 17.5 years. The average duration is 6 months. Sex: 38 males and 14 females. In 2 cases the sex was not specified.

Location of Chloromatous Growths.—The growths were situated in some part of the head in all but 4 cases, in which the examination was complete. The most frequent seats in the head were the orbits—23 cases usually involving the periosteum; the dura or sinuses—26 cases; the temporal bone, especially in the auditory region—13 cases; the temporal fossa—12 cases; less frequently the sphenoid—4 cases; ethmoid—4 cases; the choroid plexus—2 cases; the nose, nasopharynx, maxillary antrum, pterygoid fossa, soft palate, gums and mastoid. The vertebræ were affected in 14 cases, usually in the periosteum of the bodies. The ribs were involved in 13 cases. Green infiltrations or tumors were found in the periosteum of the sacrum, coccyx, iliac bones and the bones of the extremities, in the diploe of the skull and in various flat and short bones. Chloroma was found in bone-marrow in 13 cases. The liver was the seat of green growths in 15 cases, the kidneys in 16, the spleen in 8 cases. The lymph glands were frequently involved, but the cervical glands were most often involved—15 cases. The bone-marrow of the long bones was the seat of chloroma in 10 cases, in several of which the flat and short bones were involved.

Of the associated changes it is not necessary to mention any except tuberculosis. This was found in the lymph glands in the cases of Schmidt, Rosenblath, and Koerner.

As regards the clinical features, early weakness was noted in 14 cases, pallor or anæmia in 21, exophthalmos in 15, deafness in 13, swelling of the temporal region in 15, enlarged lymph glands in 16, emaciation in 12, rapid pulse in 7. Pain was often a prominent symptom and was most often felt in the head, eyes, teeth or ears, or in the hips or legs. Hemorrhages in the skin or mucous membranes were noted in 16 cases. Blindness occurred 6 times. The liver was enlarged in 5, the spleen in 10 cases. In Lang's case, a man, aged 52 years, was seized with violent pain in the head and teeth three months before admission. In Bramwell's case the most remarkable feature was an eruption, beginning in the chest and spreading all over the body, consisting of flattened elevations, often confluent. They were superficial and painless. The gums were enormously swollen, firm, and dark purple. The eruption on the skin in time became yellow, yellowish green or distinctly green. A similar eruption occurred in one of the cases reported by Treadgold.

The cases of chloroma with tumors of the orbit have close clinical relations with other orbital tumors and often result in sending the patient to an ophthalmologist. But the orbital tumors do not suffice to make the diagnosis of chloroma, as in addition to leukæmia without chloroma, lymphoma, lymphosarcoma and other formations often affect the orbits, causing exophthalmos in some cases. There may be no involvement of the skull.

Out of the protean symptoms of chloroma cases Dock distinguishes three sets of conditions: (1) The mechanical results of the green growths, causing many symptoms, both objective and subjective, as for instance exophthalmos, visible tumors, pain, deafness, etc. (2) The toxic symptoms, such as weakness, fever, and emaciation. (3) The blood symptoms, such as pallor, hemorrhages, and alterations of the blood itself.

The Condition of the Blood.—There is a resemblance between many of the symptoms of chloroma and those of leukæmia, especially of acute leukæmia. Ever since Recklinghausen assigned chloroma to the leukæmia group of diseases the blood has been the most important single clinical feature, but owing to the imperfect application of blood examinations in general, and to the failure of appreciating the nature of cases during life, the blood has not yet received so much attention in chloroma as it deserves. The blood in Rosenblath's first case showed: red blood corpuscles 1,000,000; leucocytes 300,000. "The small mononuclear lymphocytes appear in small numbers, and the polymorphonuclear neutrophiles are scanty in proportion to mononuclear forms of various sizes, the smallest of which only slightly exceed the red corpuscles; the largest reach a considerable size. The protoplasm is usually reduced to a narrow ring, the outer layer of which often stains deeply with methylene blue. The nucleus stains rather faintly, shows usually a granular or filamentous network, is round or oval, usually simple, but sometimes double. There is moderate poikilocytosis, only an occasional nucleated red corpuscle."

In Dock's case, while the blood showed some differences as compared with many cases of acute leukæmia hitherto reported, it has probably many counterparts in the latter disease. In its eosinophile cells and myelocytes it differs from Dock's 1893 case, and forms a transition from many of the other cases to that of Dunlop. In Dunlop's case the blood at first showed hæmoglobin, 32 per cent.; red blood corpuscles, 1,800,000; leucocytes, 24,500. The differential count was: lymphocytes, large predominating, 73 per cent.; polymorphonuclear, 17 per cent.; myelocytes, 5 per cent.; unclassified and transitional forms resembling myelocytes, 5 per cent.; a few nucleated red cells. The red cells fell in six weeks to 615,000; hæmoglobin, 12 per cent.; the leucocytes rose in the same time to 123,000. In Rosenblath's first case there were 300,000 leucocytes at the first examination three and a half months after the onset of symptoms. In the second case of the same author the blood was first examined eleven days after the first symptoms, and contained 40,000 leucocytes per cm., increasing in eight days to 58,000; but in two months the number was lower—37,000. The patient died ten days later. In Weinberger's case the leucocytes rose from 20,000 to 72,000 in two days. In Dunlop's case they increased from 24,500 to 123,000 in six weeks. In this case petechiæ occurred early, suggesting an alteration of the blood.

Dock says that from the data now available the relationship of chloroma to leukæmia seems settled. That the full picture of leukæmia does not always develop in all cases is to be expected. But assigning chloroma to leukæmia of course leaves unsettled many problems. One of the first questions that arises in this connection is with reference to lymphocytosis in so-called lymphosarcoma and other diseases not yet positively identified with leukæmia, but with many indications of relationship. This can only be determined by the discovery of the etiological factor.

Two other questions raised by chloroma are the nature of the color and the histologic position of the new growth.

The Color of Chloroma.—No satisfactory explanation has yet been made as to the cause of the green color. Bramwell says, "that the green discolorations, though they had hitherto been considered to be essential and characteristic features of the disease might in some undoubted cases of chloroma be absent." This shows the danger of making such a feature as color the basis of classification, especially when pertinent cases are few and the color itself is so difficult to analyze, as in chloroma. It is true that in order to deserve the term chloroma there should be a green color, but if the green color is associated with a definite structure it might be possible to make the diagnosis even if the color were absent, either naturally or as the result of preserving methods.

Treadgold thinks it very improbable that the green color is derived from ordinary blood pigment, though there is a greenish decomposition product of hæmoglobin which is never seen except in cutaneous bruises. In cases of acute leukæmia a yellowish brown pigment can be demonstrated, especially in the liver. This seldom gives the free iron reaction with potassium ferrocyanide, but is obviously derived from extravasated blood. In chloroma there usually seems to be more of this pigment, owing to the longer course of the disease and its more focal origin. The red blood cells are not so rapidly destroyed, and there is therefore more iron-containing pigment in the tissues. Abnormal myelocytes and myeloblasts are the pathogenic cells in chloroma. The green lesions are possibly due to degeneration of the granular or pre-granular protoplasm of these cells or an abortive attempt to form granulations, aided by the broken-down products of hæmoglobin. This theory is supported by the fact that no case of small round-celled chloroma has ever been reported.

VIEWS OF AUTHORS ON THE CLASSIFICATION OF CHLOROMA.

Most authors agree upon the main histologic details of chloroma. Lubarsch thought the tumors so much like lymphoma and lymphosarcoma histologically, that but for their green color the possibility of anything but lymphoma could never have been entertained. But he would separate chloroma, as well as lymphosarcoma and tumors of that kind which seem to have a toxic or infectious origin, from sarcoma and other autogenous tumors. "The former are merely a manifestation of a general diseased condition of the organism. Though they may develop in large numbers in the body each tumor must be looked upon as a primary condition and not as a metastatic formation depending on the dissemination of some primary autogenous growth; while they usually have a predilection for lymphoid tissue, they have been found in other parts of the body." Lubarsch, like most recent authors, agrees that Dock was right in emphasizing the differences between ordinary periosteal sarcoma and chloroma.

Rosenblath emphasized the difficulty of classifying chloroma among lymphomata on account of the tendency of the latter to remain within the capsule of the gland and not form metastases. "In chloroma, even the tumors of the orbit, which seem at first glance to act like lymphomata, are quite different. They have no capsule, and grow through fat, nerves, and muscles. The majority of the other larger tumors are closely united with the periosteum and grow diffusely."

Guembel, while he admits the resemblance of the tumor to sarcoma, points out that chloroma is essentially limited by mechanical conditions as regards its spread, unlike the unlimited growth of sarcoma. Another point is the impossibility of finding a primary growth. Other points of difference are: the absence of giant cells, of bone formation, of characteristic circumscribed metastases in internal organs. He too thinks that the cells of the tumor are of the same kind as the majority of those in the blood, the bone-marrow, and the splenic pulp.

While there are some contradictions and differences of opinion regarding the growths among those who have examined cases of chloroma, Dock thinks it can be said that histologically most of them have a structure that can best be compared with that of the leukæmic lymphomata. That certain variations occur, however, seems beyond question, and Dock believes that Dr. Warthin's examinations in this case reveal some important demonstrations of this fact.

Weinberger believes that in chloroma we are dealing with an acute myeloid proliferation. This is indicated by the large number of polymorphonuclear leucocytes which are present in the blood, the majority of these cells being neutrophile granular, while a few exhibit scanty granulations or none at all. A further proof is that most of the mononuclear cells show fine or coarse neutrophile granulation, and the nongranular cells are usually furnished with a basophile protoplasm, which is not as a rule found in lymphocytes. The presence of normoblasts and eosinophiles is also in favor of myeloid proliferation. He considers that it is not justifiable to regard this anatomically and clinically distinct disease as merely a symptom, and that at the same time leukæmia is not identical with sarcomatosis of the lymphoid and myeloid apparatus respectively. He considers it to be a combination form of leukæmia with lymphosarcomatous proliferation, and suggests that chloroma should be included in general lymphoid and myeloid conditions respectively.

In the case reported by Pope and Reynolds the clinical course, the history and the distribution of the lesions suggested an infective process, and by means of a special method of fixation and staining they were able to demonstrate in the green material a bacillus resembling the bacillus Mallei. The distribution of the bacillus was precisely that of the pigment, and it was especially numerous in the endothelioid and pigment cells.

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CERVICAL SUBCUTANEOUS CAVERNOUS HÆMANGEIOMA.

WITH REPORT OF TWO CASES.

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INTERMUSCULAR cavernous hæmangeioma of the neck is sufficiently uncommon and interesting to warrant placing the following two cases on record.

CASE I.—A young woman, twenty years of age, first came under observation in August, 1907. Except for the ordinary diseases of childhood she had never been ill. Immediately following convalescence from an attack of mumps when the patient was eight years of age, a small soft swelling was first noted on the right side of the neck. The swelling gradually increased in size. Since 1905 it has been intermittently larger and smaller. The variations in size were apparently causeless and did not bear any relation to the menstrual periods. When small the swelling was symptomless except for the deformity, when large it produced moderately severe shooting pains in its immediate vicinity.

On examination the patient presented a tumor the size of a small hen's egg in front of the right sternomastoid muscle, just beneath the angle of the jaw. The overlying skin projected a little above the surrounding area, but was non-adherent and was normal in color. On palpation the swelling imparted the sensation of an accumulation of fluid under slight tension. During direct pressure by the fingers the tumor projected less prominently, but at the time of the examination this was supposed to be due to its being flattened. Except for its long duration the tumor corresponded to a deep-seated cold abscess. The possibility of hæmangeioma was not considered. A diagnosis of cyst probably of congenital origin, but possibly originating in the parotid gland

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secondary to the attack of mumps, was made before operation. At four examinations covering a period of two months no appreciable change in the size of the tumefaction was noted.

The patient was operated upon at the University of Pennsylvania Hospital, October 30, 1907. A transverse incision through the skin and platysma exposed the tumor which presented an appearance similar to a vascular goitre. The dissection of the tumor from the surrounding tissues did not present any difficulties. Bleeding was free from one point where the tumor was nicked with the knife, but was easily controlled. The bleeding caused collapse of the tumor and facilitated its removal which was accomplished after clamping hæmostats on two small veins above and one below the tumor. On cross section the tumor resembled the erectile tissue of the corpora cavernosa. The platysma and skin were sutured in separate layers. The wound healed by first intention.

Case II.—The second patient was a man twenty-eight years of age who had recently come to this country from Turkey. He had had a swelling of the neck from early childhood. The tumor increased slowly but steadily in size. At the age of fifteen years an exploratory incision was made under local anæsthesia but the removal of the tumor was not attempted. An immigration commissioner brought the patient to the Philadelphia Hospital to ascertain if the tumor constituted a legal barrier to his remaining in the United States. The patient was admitted on the service of Dr. Edward Martin through whose kindness I was permitted to operate.

The examination disclosed a rounded slightly elevated nonpulsating tumor of indefinite outline situated on the left side of the neck. It extended from the median line to the sternomastoid muscle and from just beneath the inferior maxilla to a line two inches above the clavicle. About the middle of the tumor was an unsightly ovoid scar resulting from the exploratory incision. The overlying skin did not present any abnormalities in color and was not adherent to the deeper tissues except at the scar. On palpation it simulated a fibrolipoma, being composed chiefly of soft tissue in which could be felt irregular fine bands and small nodules of firmer tissue. The tumor could be diminished in bulk by pressure but promptly regained its original size on relief of pressure. The most striking symptom was an enormous

Fig. 1.

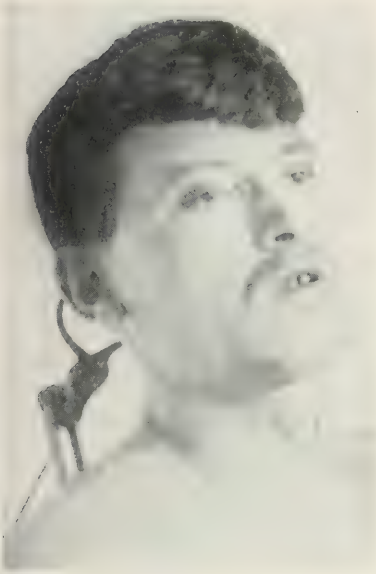


Fig. 2.

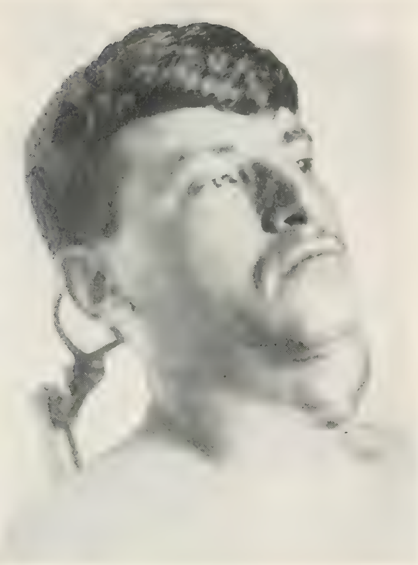


Fig. 3.

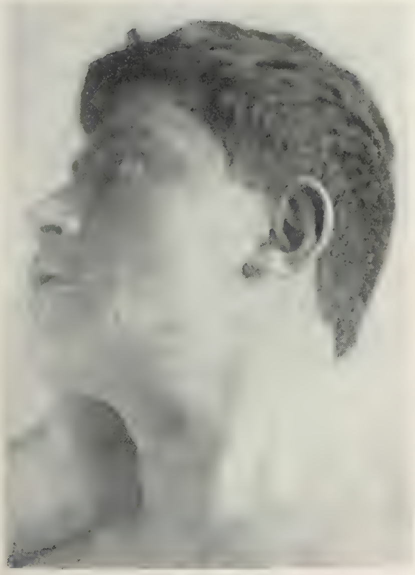
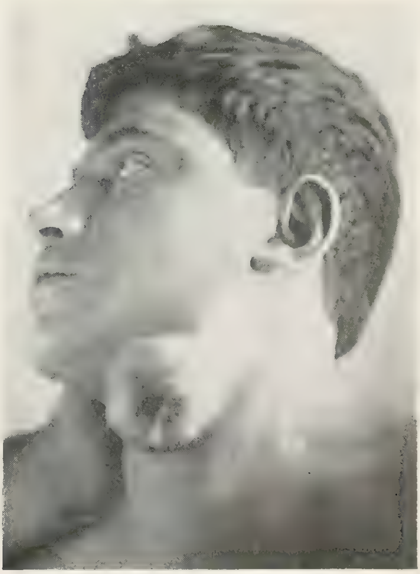


Fig. 4.



Figures 1 and 3 represent the tumor in passive state, and figures 2 and 4 the distended tumor.

increase in size produced after deep inspiration by forced expiratory efforts with the glottis or the mouth and nose closed. This is well illustrated by comparison of Figs. 1 and 3 with Figs. 2 and 4. The tumor would increase in size during the entire period of a single expiratory effort prolonged to the point of fatigue, but would not gain its maximum size until the patient had quickly taken a second inspiration and repeated the straining effort at expiration. In the short interval between the two expiratory efforts the tumor decreased but little in size. On cessation of straining the tumor shortly returned to its original outlines. Deep inspirations or direct pressure hastened the subsidence of the swelling. Pressure over the course of the internal jugular vein at the base of the neck caused a slight enlargement. Percussion over the tumor in its passive state yielded a tympanitic note practically identical with the corresponding area on the opposite side of the neck. When the tumor was fully distended the percussion note over it was still tympanitic but somewhat higher pitched than on the opposite side. Auscultation over the tumor during quiescence and during alterations in its size failed to elicit any adventitious sounds. The tumor did not give rise to any pressure symptoms. Examination of the mouth, pharynx and larynx failed to reveal anything abnormal. Examination of the pharynx while the tumor was fully distended was not made, but, as shown by the findings at operation, it probably would have revealed a bulging of the lateral pharyngeal wall. A diagnosis of hæmangeioma was made prior to operation.

In March, 1908, a transverse elliptical skin incision so placed as to remove part of the old scar was made across the central part of the tumor. The platysma over its area of attachment to the tumor beneath the scar was not disturbed but elsewhere was dissected back with the skin flap. The angiomatous tumor thus disclosed was approached at its lower border and gradually enucleated from below upward. The anterior projection of the tumor lay in direct contact with the wall of the pharynx between the superior and middle constrictor muscles. After removal of the tumor from this region the pharyngeal mucosa flapped in and out with each respiration. The posterior portion of the tumor was situated beneath the sternomastoid muscle in close contact with but not adherent to the internal jugular vein and carotid artery. Seven veins about the size of the median basilic vein entered the tumor at various points along an arc extending from immediately below the hyoid bone to the angle of the jaw. A large venous trunk about three-fourths of an inch in length connected the deep surface of the tumor with the internal jugular vein on a level with the hyoid bone. Except for a few very fine arterioles there were no arteries entering the tumor. There was no true encapsulation of the tumor but the line of cleavage between it and the surrounding tissues was distinct and easily followed during the dissection. The operation was not difficult and was practically bloodless, but was somewhat tedious owing to the uncertainty of the conditions to be encountered. After excision of the tumor, the middle and superior constrictors were approximated with a few sutures to support the wall of the pharynx, and the platysma and skin were united in separate layers. The patient made an uneventful recovery.

Microscopical examination of the excised tumor revealed typical cavernous angioma with an admixture of fibrous and fatty tissue in both cases.

Cavernous hæmangeioma is a vascular tumor having a structure similar to that of the corpora cavernosa. The intercommunicating blood spaces are punctiform to a pea size or larger and are lined with endothelium. The supporting connective tissue network in some instances may contain a small amount of smooth muscle fibres and elastic tissue. The blood spaces of the tumor have no connection with the capillaries of the surrounding tissues (Ribbert). The blood which circulates through the tumor is supplied usually by the venous system, rarely by the arterial. Cavernous hæmangeioma may involve the skin, subcutaneous tissues, intermuscular tissues, muscles, bones and viscera. It occurs more commonly in the female sex. An hereditary tendency has been observed but not with sufficient frequency to be worthy of any great consideration. Trauma has been ascribed as a predisposing factor but it probably has served to direct attention to the lesion rather than to cause it.

Pathologists are by no means agreed as to the mode of origin of cavernous hæmangeioma. Some regard it as a primary neoplasm and others advance numerous theories to account for its development secondary to changes in the vascular and lymphatic systems and the connective tissue. Cavernous hæmangeioma may be single or multiple. If multiple the individual lesions may be adjacent to one another or may occupy widely remote regions. Subcutaneous and cutaneous hæmangeiomata occasionally coexist either in the same region or in widely separated areas. A cavernous hæmangeioma may arise primarily as such or it may develop secondarily by transformation of a simple hæmangeioma.

Subcutaneous cavernous hæmangeioma has frequently been observed at birth, thus proving that it may be congenital. More commonly, however, it first comes under observation during childhood and occasionally later in life. Even these cases may be and probably are congenital in origin but escape attention owing to their deep situation and early latency or slow growth. As a rule, the first symptom to attract attention is the presence of a swelling which projects above the surface. The overlying skin is normal in appearance and is not adherent. A bluish tint is sometimes apparent through the semitranslucent skin of young children, particularly when the tumor is distended. Neuralgic pain from nerve pressure is sometimes present but is an inconstant symptom. The tumor is characterized by transient variations in its size depending upon the amount of blood contained in the cavernous tissue. Factors causing an increase in the general or local venous blood pressure as crying, coughing, straining, dependant position of the affected region and pressure on the efferent vessels produce an enlargement of the tumor which subsides as soon as the venous tension returns to normal. The size of the tumor can be diminished temporarily by direct pressure, by elevation of the part or by compression of the afferent vessels. The extent to which the tumor can be made to disappear by manual pressure depends upon the number and size of the blood spaces, the thickness of their intervening walls and the amount of connective tissue stroma. When fully distended the subcutaneous tumor imparts to the palpating fingers the sensation of a tense cyst. Depending upon the relative proportion of vascular spaces and connective tissue stroma the flaccid tumor on palpation may simulate a cold abscess, a lipoma or a fibroma. Phleboliths when present are palpable as shot-like bodies. There may be a transmitted pulsation from an underlying artery and in the exceptional instances in which the hæmangeioma has an open communication with an artery expansile pulsation and bruit are present. Hæmangeiomata yield a flat note to percussion.

The clinical course of these tumors varies greatly in the individual cases. They may enlarge slowly or rapidly from the first or they may remain quiescent for years. Periods of rapid growth may alternate with periods of slow growth, latency or actual diminution. They rarely exceed the size of a man's fist. Continued growth may lead to coalescence of the central blood spaces and the formation of a blood cyst having a shell of cavernous tissue at its periphery. As the result of traumatism or infection a cavernous hæmangeioma may become swollen, hard, tender, and irreducible. The inflammatory process may subside completely without having caused any demonstrable alterations in the angioma. Thrombi, however, may form in the blood spaces and in the blood-vessels connected with the tumor, and their subsequent organization will lead to a partial or complete cure. Some of the thrombi may become calcified and persist as phleboliths. Even in the absence of inflammation a hæmangeioma may undergo retrogressive changes and spontaneous disappearance. A cavernous hæmangeioma not infrequently may participate in the formation of a mixed tumor, particularly with a lipoma or fibroma. Rarely a hæmangeioma may be the starting point of a sarcoma or an endothelioma. Cavernous hæmangeioma of the neck may originate in the skin, subcutaneous tissues or intermuscular tissues. Intramuscular hæmangeioma has never been reported in the cervical region. The deep seated hæmangeiomata tend to extend toward the surface and the superficial to extend deeply so that long standing large tumors are prone to involve all three planes of tissue.

Those which begin superficially, however, commonly show a much greater extent of cutaneous involvement than those which originate in the deeper tissues. Strictly speaking, the two cases here reported, being situated beneath the platysma, belong to the intermuscular variety, but in the further description of these cases no attempt will be made to differentiate the intermuscular from the subcutaneous forms.

The subcutaneous cervical hæmangeiomata when large may give rise to dysphagia, dyspnœa and dysphonia. An angeioma is affected by respiratory straining in the cervical region to a greater degree than in any other part of the body. A hæmangeioma located anterior to the sternomastoid muscle lies in such intimate relation with the trachea, larynx or pharynx that the percussion note over it is resonant or tympanitic. A higher pitched note is obtained, however, (1) by percussion over the tumor than over a corresponding point on the opposite side; (2) by superficial than by deep percussion and (3) by percussion over the fully distended tumor than over the compressed tumor. The lesions most apt to be confounded with a cervical subcutaneous cavernous hæmangeioma are aërocele, lymphangeioma, aneurism, cysts, hernia of the lung, cold abscess, fibroma and lipoma.

A hæmangeioma at the front of the neck may resemble an aërocele, in being resonant or tympanitic, compressible and distensible; in causing disturbances of speech and respiration and in having its volume influenced by respiratory straining. In my second case it was only after repeated examinations that aërocele was definitely excluded. An aërocele, however, is somewhat more frequent in males and it occurs with about equal frequency at all ages, whereas hæmangeioma is more common in the young of the female sex. Aërocele may give a preceding history of violent straining as during childbirth, prolonged coughing, traumatism, intralaryngeal or intratracheal ulceration or cervical abscess rupturing into the air passages. An aërocele has a direct connection with the trachea (tracheocele) or larynx (laryngocele) from which it cannot be displaced, whereas the angeioma may not present any such intimate relation. Examination of the interior of the larynx and trachea may reveal an opening communicating with the tumor in aërocele or possibly a bluish discoloration of the mucous membrane in angioma. The aërocele is more completely reducible than the angioma and its distention can be prevented by pressure over the point of its communication with the air passages. The size of the angeioma is influenced by pressure over the vessels. As a rule, respiratory efforts produce a more prompt change in the volume of the tumor in aërocele than in angeioma.

A lower pitched resonant or tympanitic note is obtained by percussion over an aërocele than over the surrounding area or over the corresponding region on the opposite side of the neck. The percussion note is likewise lower pitched when the aërocele is distended than when it is collapsed. The reverse is true with an angeioma.

Auscultation demonstrates adventitious sounds coincident with respiration in the aërocele and is negative in angeioma except in the rare cases where the tumor has an open communication with an artery and then a bruit will be heard coincident with the pulse. A skiagraph may reveal the presence of phleboliths in an angeioma. An exploratory puncture with a hollow needle will obtain blood from the angeioma and a gush of air from the aërocele. The escape of air usually is sufficiently forcible to be manifest, but may be demonstrated by attaching to the needle a rubber tube one end of which is held beneath the surface of a liquid. Aërocele does not enter into the question of differential diagnosis in the case of an angeioma situated posterior to the sternomastoid muscles.

Cavernous lymphangeioma may present symptoms identical with cavernous hæmangeioma with the exception that the exploring needle will withdraw a serous or milky fluid in place of blood. Cavernous lymphangeioma, however, usually occupies a superficial position in the neck and is adherent to the skin, in which case the absence of skin discoloration points to the diagnosis of lymphangeioma as against hæmangeioma.

Aneurisms of the neck usually assume an elongated form in the course of the larger vessels and are found in patients beyond middle age. Hæmangeiomata usually assume a globular or flattened outline and are found in the young. In traumatic aneurisms the history points to the diagnosis.

Hæmangeioma can be diagnosed from the majority of cysts and solid tumors of the neck by the alterations in its volume during compression and distention. The diagnosis from air cysts having an open communication with the respiratory passages has been discussed under the term aëroceles. In cases of cysts and diverticula communicating with the pharynx or œsophagus diminution in size from direct pressure is associated with a regurgitation of mucus or food.

Vascular goitre may simulate hæmangeioma by its variations in size incident to alterations in the local blood pressure, but the position and outline of the growth and the associated solid enlargement of the thyroid serve to exclude it. Intermittent enlargement of a salivary gland from incomplete obstruction of its duct might suggest hæmangeioma, but its situation, the swelling coming on during or immediately after meals, often accompanied by salivary colic, the diminution on direct pressure causing a flow of saliva from the affected duct, and the associated signs of a stone or stricture in the duct, serve to differentiate this condition.

The differential diagnosis of hæmangeioma from blood cysts which have preserved their communication with the boodvessels is impossible. The more nearly complete the disappearance of the tumor by direct pressure the greater is the probability of its being a blood cyst. The presence of other angeiomatous tumors favors the diagnosis of cavernous angeioma as opposed to blood cyst.

Hernia of the lung is always found at the base of the neck, is usually completely reducible, can be prevented from recurring by pressure over the opening through which it escapes, yields crepitation on palpation and breath sounds on auscultation. Hæmangeioma is more common in the upper cervical region, is incompletely reducible, may be affected in size by pressure over the blood-vessels connected with it, usually presents the signs of an admixture of fatty and fibrous tissue, may contain phleboliths and is negative to auscultation, except in rare instances when bruit may be obtained.

Subcutaneous cavernous hæmangeioma is such a comparatively rare tumor that the possibility of its occurrence was not considered in most if not all the reported cases erroneously diagnosed as cold abscess, lipoma, fibroma or fibrolipoma. In none of these cases was the erectility and compressibility of the tumor noted. Had tests been employed to determine the presence of these symptoms a faulty diagnosis might have been avoided. It is also probable in these cases that the clinical picture was not in perfect accord with the condition diagnosed. In my first case, for instance, the local findings simulated cold abscess, but the history of its beginning as a soft painless swelling and the duration of twelve years excluded that diagnosis. In the second case the collapsed tumor resembled a fibrolipoma on palpation but was atypical of the latter neoplasm by reason of its flaccidity. The difficulties of diagnosis are illustrated by Fisher's case of angiofibroma involving the tongue, floor of the mouth and upper part of the neck. Fisher recognized the fact that he was dealing with an unusual tumor and made repeated punctures from the skin surface with a hollow needle. Blood was obtained but once. The point of the needle apparently was buried in the fibrous tissue in the remaining trials.

The clinical history of a hæmangeioma resembles that of a cold abscess in those cases in which the angioma has escaped observation up to the time of its developing an inflammatory induration which may resemble a lymphadenitis, and the subsequent softening on subsidence of the inflammation may be mistaken for the breaking down of glandular tissue.

The occurrence of a fibroma or lipoma in the form of a mixed tumor tends still further to obscure the presence of the angiomatous elements.

The clinical features of a cold abscess, lipoma and fibroma are too well known to require discussion. In any given case suspected of being one of these conditions, but which in any way is atypical, the examination should be conducted with a view to determining the possible presence of the compressibility and distensibility characteristic of angeioma.

A subcutaneous hæmangeioma of the neck which is quiescent or undergoing spontaneous resolution may be treated expectantly but should be kept under observation. A continued increase in size calls for active interference.

Electrolysis, the injection of coagulating fluids, the introduction of magnesium darts, subcutaneous ligation and similar forms of treatment are attended by serious risk of damage to adjacent important structures, particularly if persisted in to the point of complete disappearance of the tumor. One or more of these methods might be employed in cases of very large angeiomata, to reduce their size preliminary to excision, but their beneficial effect is apt to be counterbalanced by the production of adhesions.

If the claims made for radium be substantiated it will prove the most acceptable form of treatment, otherwise complete excision is indicated. Complete destruction or removal is necessary to guard against recurrence.

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ANEURISM OF THE INTERNAL CAROTID TREATED BY MATAS' METHOD.

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AND

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We believe that the following case is worthy of reporting because, first, no similar case of aneurism of the internal carotid surgically treated has ever been reported, and, second, because the technical difficulties encountered in this case (which necessitated freeing the aneurismal sac from the surrounding structures) and the subsequent sloughing of the sac wall as a result probably of insufficient blood supply, add something to our knowledge of the factors which determine success or failure in conservative aneurismorrhaphy.

Case.—Mrs. M. B., age 60; referred to us by Dr. Bates. One year ago she first noticed a pulsation in right side of neck, and since that time there has been a painless pulsating, gradually but steadily developing mass just above the bifurcation of the carotid on right side of neck. There has been no evidence of nerve involvement, no cerebral symptoms and the general health of the patient has remained good. The patient's previous medical history is not noteworthy and nothing can be elicited to suggest a specific infection.

Examination shows a small framed, fairly well-nourished, well-preserved woman. Beneath and behind angle of jaw on the right side is a pulsating mass apparently about 3.5 cm. in diameter. This mass is equally prominent internally in the region of the tonsil. The usual physical signs of aneurism are present. General physical examination negative.

Operation.—December 29, 1908. Ether anæsthesia with Crile nasal intubation. Vertical incision anterior to sternomastoid. Exposed common carotid and applied Crile clamp. Dissected upward anterior to internal jugular, ligating anterior venous and occipital and ascending pharyngeal branches of external carotid. Saccular aneurism of internal carotid arising 4 cm. above bifurcation. Sac about 4 cm. in diameter. Impossible to control return blood without dissecting sac free from adherent tissues. Pull on vagus reduced heart beats from 70 to 40 per minute for a half minute or less. Placed Crile clamps on internal carotid above and below aneurism, also untied ligatures to be used in case of emergency. Opened sac longitudinally and removed some fresh blood clot. Neck of sac sharply defined arising from about 2 cm. of artery. Closed sac by four rows of through and through silk sutures (No. 12 cambric needles and No. A silk, saturated with vaseline) the first row being so placed as to close the neck of the sac with preservation of lumen practically without narrowing. Removed Crile clamps and emergency ligatures. Only slight bleeding from stitch holes—easily controlled by temporary gauze pressure. Vessel pulsating normally when last seen. Incision closed with deep plain catgut sutures; horse-hair skin sutures. No drainage. No bad effects noticed from temporary compression of internal carotid, which lasted about twenty-five minutes.

December 31, 1908.—General condition of patient good. Paralysis lower branches of facial on right side (cut during operation). Decided weakness of left arm. Slight weakness of left leg. Yesterday patient was dull and apathetic and at times slightly delirious, but mental condition is much better to-day.

The mental condition and the weakness in left leg improved rapidly but weakness in left arm persisted with apparently fairly marked variation from day to day. The post-operative history was otherwise entirely uneventful until the eighth day when the patient developed a sore throat and stiff neck, with a temperature of 102 degrees. At this time a swelling was noticed in the region of the wound and the same was opened by blunt dissection and about 30 c.c. of serosanguinous fluid evacuated. Temperature and sore throat subsided on the twelfth day and patient was discharged apparently well on the fifteenth day, her condition being apparently perfect except for a slight weakness of the left arm.

Three days after leaving the hospital a hæmatoma formed beneath the scar, which was opened and drained. The next day there was a moderate hemorrhage. On the twentieth day following the operation a large hæmatoma formed in the neck and it was decided to reopen the wound and ligate the bleeding vessel. Under ether the incision was opened and immediately there was an alarming hemorrhage. The common carotid was at once clamped, but the hemorrhage came chiefly from above and all clamps placed on the internal carotid above the site of the aneurism simply ruptured the friable vessel wall. The hemorrhage was finally controlled by packing, but the patient died within a few hours from the effects of the hemorrhage. Examination at time of second operation showed that the flaps of the aneurism sac had apparently sloughed. The secondary hemorrhage came apparently from the junction of the upper end of the sutured aneurism sac with the internal carotid.

No autopsy was permitted.

AN OPERATION FOR PARALYTIC SHOULDER JOINT DUE TO INFANTILE PARALYSIS.*

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I wish to report to this society a case of paralytic shoulder joint due to infantile paralysis, upon which I operated to improve a function. Its history is as follows:

The patient, a girl of sixteen, presented herself with a typical dangling shoulder joint, for examination to ascertain whether the function of the left upper extremity might be improved. She gave the following history. The past history shows nothing of importance. The present history goes back to a time nine years ago, when she began to complain of pain in her left wrist which she attributed to pulling a boat on shore. The same evening she complained of a headache which persisted until the following morning, when she had a chill and high temperature. She had no convulsions, did not vomit, nor did she complain of pain anywhere. Temperature persisted for three days, at the end of which time her mother noticed that the patient was unable to move her left arm. She was treated for a year for this by an osteopath with no result but rather a progressive atrophy of the arm and a continuing loosening of the shoulder joint. She then went to an orthopædic surgeon who put her arm in a splint in flexion at the elbow, with the result that motion of the elbow gradually became diminished.

She comes to the hospital now on account of being unable to move her left arm in any direction, except slight inward rotation. She also complains of inability to flex the forearm. She does not complain of any sensory disturbances. Chief complaint: inability to use left arm.

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* Read before the New York Surgical Society, Oct. 27, 1909.

Inspection shows a typical flail-like appearance of the left upper extremity. It hangs straight downward with a slight inward rotation. The fingers are somewhat flexed. The head of the humerus hangs down from the acromion over two and one-quarter inches. The entire extremity appears highly atrophied.

Passive motion in the shoulder joint is possible to an excess. Active impossible. Passive motion of the elbow shows that flexion and extension are perfectly free, but pronation and supination are reduced to a minimum. There is slight paradox insufficiency of the flexions of the hand owing to their shortening. There is atrophy of the interossei.

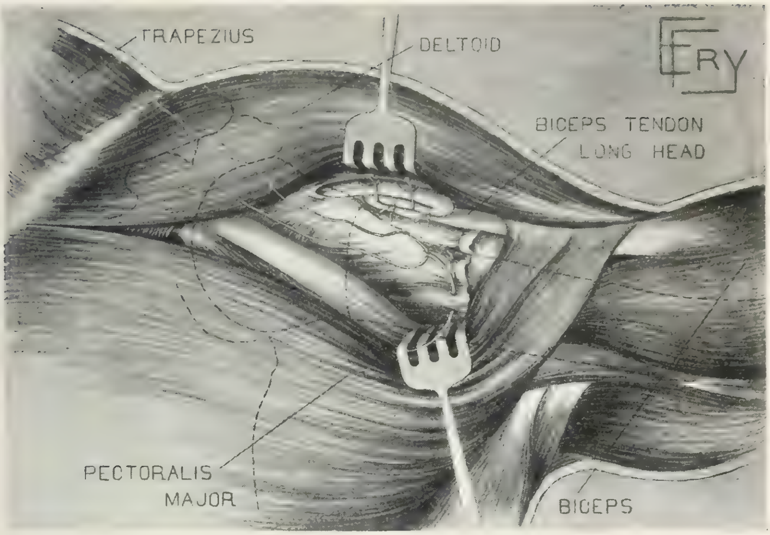
The active function of the arm is *nil* except a slight forward motion. Abduction is entirely absent. The arm cannot be moved away from the hip. Outward rotation does not exist. A slight inward rotation is possible.

The practical use of the arm is as follows: If the hand and forearm are brought backward by the other hand, the patient can tie her skirt strings. She can dress her hair by sitting low next to a high dressing table, upon which she brings her left elbow with her right hand, whereupon she can use her forearm, and then fix her rather complicated coiffure.

Besides the loss of function the cosmetic effect of the dangling shoulder with its pronounced atrophy is rather annoying to the young woman, the atrophy showing quite plainly even when the patient is dressed. Close examination of the undressed patient reveals a slight atrophy of the left lower extremity which is unknown to the patient or her mother. There are no functional disturbances in the lower extremity.

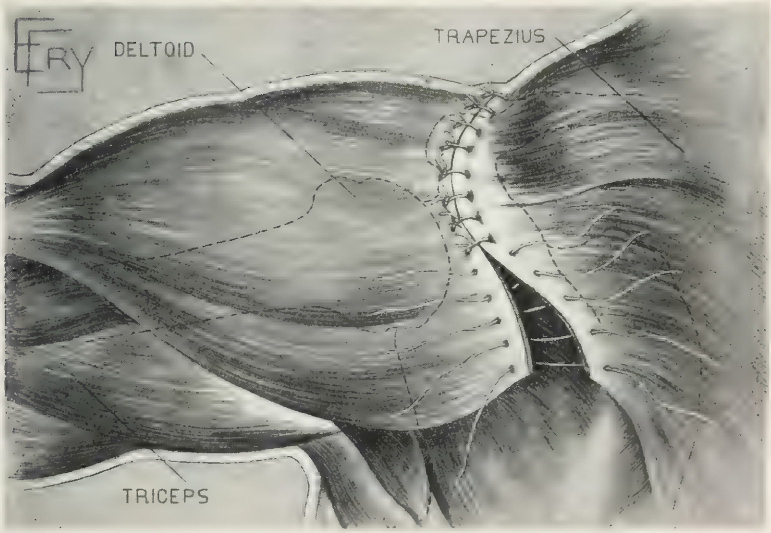
The nerve status is as follows: Cranial nerves—no disturbances. Upper extremity—right upper extremity appears normal in contour, motion, and sensation. Left upper extremity—no sensory disturbances. The left arm appears extremely thin, and flail-like. There is complete atrophy of the deltoid, biceps, triceps, brachialis anticus, coracobrachialis, supraspinati, and teres major and minor. All these muscles give a complete reaction of degeneration. The patient is unable to move her left arm in any direction except to rotate the arm inwardly to a slight degree. The left forearm shows no sen-

FIG. 1.



First stage of operation. Front view, arm elevated.

FIG. 2.



Rear view.

Fig. 3.

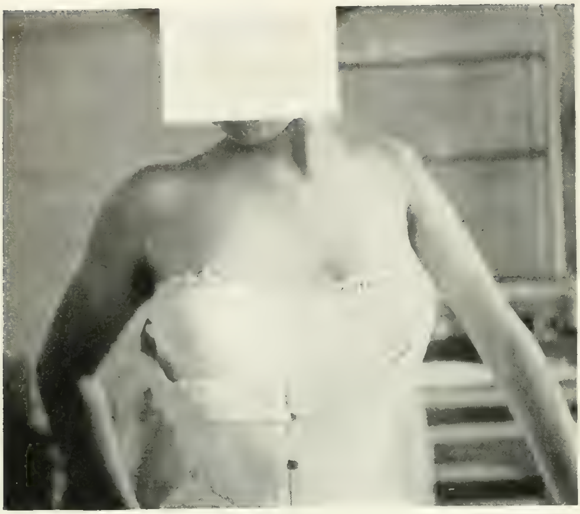
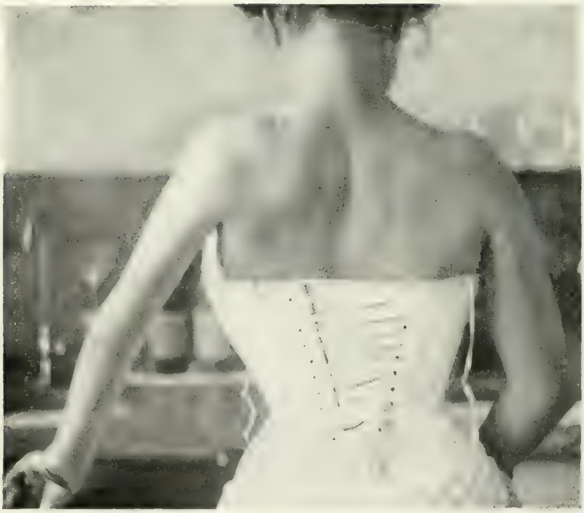


Fig. 4.



sory disturbances, and no motor disturbances. The patient is unable to flex the forearm voluntarily except when it is flexed to ninety degrees. She can then voluntarily flex it further. In the hand there are no sensory or motor disturbances except a diminished opponens action of the thumb. There is atrophy of the interossei. Reflexes present in forearm but not in arm.

Trunk—no sensory or motor disturbances.

Lower extremities—no sensory or motor disturbances. Reflexes active. Slight atrophy of the thigh and leg visible to the eye and shown by a slight difference in the measurements.

There is quite a lateral curvature of the spine which has developed owing to the diminished weight of the left upper extremity, and the lack of its use.

With the history of a three days' high fever, after which the left upper extremity appeared paralyzed, there could be no question that the condition described was due to infantile paralysis. It is only surprising that this diagnosis had not been made before.

To improve the function, especially to give the patient abduction, which was absolutely absent, it was a question whether arthrodesis was to be performed or some other operation.

The opinion expressed in the "Handbuch der Orthopædie," that an upper extremity whose muscles are completely paralyzed is a perfectly useless appendage, even if the muscles of the forearm are intact, is not correct. It is true that the pectoral and latissimus dorsi can only produce a certain swinging motion, but as you have seen from my description of the status, the arm could be used to quite some purpose. Therefore, I came to the conclusion that arthrodesis, even if it was a success, would diminish the usefulness of the arm. It would then have been impossible to bring the hand back to tie the skirt strings, and the passive elevation of the arm in the shoulder joint to dress the hair would also have been obliviated. I therefore concluded that I would make the following operation, consisting of three parts:

On May 19, 1909, an incision was made about nine inches in length at the anterior border of the deltoid. The capsule was easily exposed and severed horizontally at its insertion to the humerus in about three quarers of its circumference. The biceps tendon was not cut through. The free upper border was sewed down to the periosteum of the humerus about two inches and a half lower down. This was done while the arm was brought in horizontal position. Then the long tendon of the biceps was pulled through the intertubercular mucous sheath of the capsule, and the surplus material used to make a double loop which was sewed together.

These two steps in the operation brought the head which had been hanging down more than two inches and a quarter hard up against the glenoidal fossa. Then I dissected the deltoid from the clavicle and the acromion entirely, so that the upper border was completely free. Then the insertion of the trapezius was severed from the two bones named. The free edges were then united by interrupted chromic catgut sutures, thus making one muscle out of the shoulder part of the trapezius and the deltoid.

The wound was completely closed and healed promptly by primary union. The arm was dressed in abduction. In seven days the wound was completely healed, but the abducted position was kept up for two weeks more. A prolonged fixture in this position, to avoid stretching of the tissues shortened, was not deemed advisable to avoid possible stiffness of the joint.

Three weeks after the operation the patient began to use her arm, and slowly could abduct the arm from the hip. The accompanying photograph shows how much she could abduct the arm three months after the operation. The contraction of the cucularis, which by its attachment to the deltoid lifts the arm, is seen very plainly in the photograph showing the patient from the rear.

It could not be expected that a complete elevation of the arm could be achieved, as the paralysis had existed for nine years.

Besides the new function, abduction, which may increase later on, the cosmetic effect is quite marked as the shoulder appears now round, and does not show any deformity when the patient is dressed.

The idea of implanting the deltoid into the cucularis is Hoffa's, who has done this operation as far as I find, twice.

Koelliker has shortened an unduly long stretched capsule by shirring it.

To use the tendon of the biceps to suspend the arm in its proper position has not been described in the literature available to me.

The combination of the three operations appealed to me as rather reasonable, and the patient and I are both well satisfied with the result.

THE SURGICAL TREATMENT OF EMPYEMA THORACIS.

BY CHAUNCEY E. TENNANT, M.D.,

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WHILE the surgical possibilities in the thorax have been increased during the recent experimental period, and especially since the introduction of the Sauerbruch negative pressure cabinet,[1] the results attained in pulmonary work have not as yet proven altogether satisfactory. Although the writer firmly believes that successful pulmonary surgery will be one of the triumphs of the near future, he also believes the infections limited to the pleural space have not yet yielded to the old and well tried methods such results as we have a right to expect.

That so many of our cases of empyema thoracis should require extensive rib resections, with its prolonged disability, or that we should have the protracted sinuses, suggests the probability that we may not yet be applying the proper early treatment to our cases. We seldom meet with such difficulties in the abdominal cavity, and we should expect to secure equally favorable results in the thoracic cavity.

Murphy[2] has recently recommended and systematically used in all his cases of postpneumonic empyema (in which there is no pulmonary gangrene abscess or bronchial communication) a method of simple aspiration of the purulent effusion, and with the same needle still in place, introducing one or two ounces of a twenty-four-hour old two per cent. solution of formalin in glycerin. This treatment is usually repeated every two to four weeks, until the fluid becomes serosanguinolent and is later absorbed. He claims for this treatment the speedy cure of the majority of his early cases of empyema.

It would seem, however, quite improbable that by this method the entire collection of pus could be removed. Then, too, one is not always certain that the fluid is circumscribed in the pleural space, for inaccessible patches of purulent material may be left well out of reach of the aspirating needle and its hygroscopic solution. While these last possibilities stamp this method as not altogether a good surgical procedure, the general principle of the treatment is sound, since the normal intrathoracic atmospheric pressure difference remains undisturbed.

Various suction devices have been suggested and used for many years, all with the idea of an early lung expansion, notably among these is the method of Weller Van Hook,[3] which is a stationary vacuum chamber maintained by an ingenious syphon device—this chamber being attached by a long rubber tube to the drainage tube and the latter inserted into the thoracic incision made by the excision of a portion of one or more ribs. The long rubber tube connection makes it possible for the patient to move about the room with considerable freedom.

Bryant [4] has recently advocated the attachment of a deflated elastic rubber bulb such as the Pulitzer bag, this to be attached directly to the drainage tube which is fairly well sealed in place by rubber sheeting and emptied of its contents when fully expanded. Brewer [5] refers to the use of the glass cup connected to a collapsible rubber bulb, such as is more recently known as the Bier hyperæmia device.

In each of these methods, with the exception of the latter, the flaw in the technic is the use of the drainage tube left in the cavity for so long a time, this being one of the strong factors in the production of the persistent sinus. The same criticism may be made of the writer's air-check device, reported in the *Journal of the American Medical Association*, November 16, 1907.[6]

Recent experimental work in the thorax with the negative[7] or positive pressure apparatus, and also without this device, successfully demonstrates the possibility of intrathoracic work, providing the lung does not collapse,—or in the event that it should, the possibility of its early restoration to a normal degree of expansion. This simple principle applied to the treatment of purulent accumulations in the pleural cavity seems to be the secret of success in effectually shortening the convalescent period in the early cases of empyema following pneumonia. To secure this expansion with a foreign body, such as a drainage tube, inserted through a wound into the pleural cavity, seems to the writer an utter impossibility. Then too, the longer the period of delay in the recovery of these cases the greater becomes the thickening and contraction of the pulmonary pleura, and when this organized fibrous covering has formed about the lung it is too late to undertake anything short of an extensive thoracoplasty.

As has already been suggested, to secure an early successful pulmonary expansion, either of two now well-known methods may be employed; that of positive pressure by forcible introduction of air into the bronchial tubes and air cells, or, by the exhaustion of a certain amount of air from an enclosed and air-tight compartment in which the thoracic cavity is placed, with the respiratory passages exposed to the natural atmospheric pressure.

In either event, it is naturally implied that there must be a direct opening into the pleural cavity. Where there is a direct communication with a bronchus, however, pulmonary expansion by this means is not so readily obtained, although in empyema after the removal of the hydrostatic pressure of the purulent fluid within the cavity, this complication often quickly disappears.

While the radical operative methods of free rib resection sometimes used in the early history of these cases should be mentioned only to be condemned, still the early adoption of free and effective drainage of the pus cavity is more likely to secure the early reduction of the pleural hydrostatic pressure and the sequent pulmonary expansion. To secure this, a portal of reasonable size and stability must early be obtained, and is best secured by the partial subperiostal single rib resection. This method makes possible the early restoration of the bony framework of the chest, which in children is an especially important feature for their future development.

The site selected for the incision should be a little below the middle of the largest area of flatness, regardless of other landmarks. Even in the most desperate cases, with the patient in a sitting posture and the weight of the upper extremity so distributed as to leave the sound side of the chest free for the necessarily increased respiratory effort, a light anæsthetic may be safely given, and an opening quickly made. The finger should then be rapidly passed about the pleural space to free all circumscribed areas or encapsulations of pus, and then two or three large fenestrated drainage tubes should be so placed as to reach every pocket. Where the writer is in doubt as to having reached all these pockets, an ordinary uterine probe is introduced and swept around between the two pleura quickly, securing the desired results; and a rubber tube in the jaws of the long uterine forcep placed well down in the depth of this newly opened space insures effective drainage from this point.

For the first five days there is no effort to remove these drainage tubes, nor to secure lung expansion; but a strong suction syringe is applied to the mouth of each tube several times a day, to withdraw the plugs of coagulated serum usually found in the early history of these cases. This is not so necessary where the empyemas are of longer standing and nothing but pus is found in the dressings.

If the tubes have been well placed and are large and have been kept free from fibrin plugs, it is usually possible to remove them on the fifth or sixth day. As soon as this is done, the time for the application of methods for lung expansion has arrived. If there is no direct communication with a bronchus, the application of the hyperæmic cup completely covering the opening, and kept in place for a half hour or more, combined with forcible expiratory effort by the patient, rapidly expands the damaged lung and drains the cavity.

In case the temperature rises and a new focus occurs after the removal of the tubes, the writer has been in the habit of carefully inserting a long blunt probe with a curved extremity which curve should conform to the contour of the chest wall. This probe carefully directed down to the new focus and the two pleura separated, followed by application of the suction cup, has soon drained and closed this space.

When necessary, one may strap the hyperæmic cup in place over the opening and maintain a constant negative thoracic pressure, the patient being able to manipulate the bulb when necessary to increase the vacuum. It is surprising to see how quickly the incision closes under this treatment, being in the writer's experience not longer than seventeen days. In fact, in order that one may be absolutely sure that there is no pus remaining, it is sometimes necessary to separate the walls of the drainage site for several days prior to allowing it to permanently close. Where a persistent sinus and small cavity remains Ochsner[8] recommends the injection of Beck's vaseline bismuth subcarbonate paste into the sinus opening.

In concluding this brief article, the writer desires to especially emphasize three points in the treatment of empyema thoracis:

First: The early attainment of an opening so located as to secure a large and free drainage, followed by the introduction of fenestrated tubes of sufficient calibre to quickly and effectually drain the cavity.

Second: The removal of these tubes at the earliest possible moment, after they have done their work, and

Third: The application of the Bier hyperæmic cup to drain the cavity after the tubes have been removed; this treatment to be continued until the lung is well expanded and the parietal pleura permanently closed.

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STUDIES OF PANCREATITIS AND THE PANCREATIC REACTION OF CAMMIDGE.*

BY JAMES TAFT PILCHER, M.D.

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THIS work has been undertaken in order to reach a more positive conclusion regarding the claims brought forward by Mr. Cammidge of London, that he was able to obtain a specific reaction in the urine of persons who are the subjects of pancreatic involvement.

In the series of cases here reported in which pancreatitis was said to have been present, only those have been so classified which were shown at operation to present such marked enlargement that a mistake in diagnosis was improbable.

The recitation of the involved test, or of the minutiæ of technic is unnecessary here, except that it has only been through the development of the latter that the data for this paper has been made apparently worthy of publication. It is possibly because other observers have not sufficiently regarded the precepts of laboratory precision that they have obtained results so at variance with those of Mr. Cammidge. In the earlier work the profusion of positive reactions was astonishing. It was only after much experience that I learned to use nothing but distilled water in every step, including the washing of the glassware, a most important point.

The results of this early inaccuracy have been discarded and the cases which have been classified in Tables I and III are the only ones considered in these statistics. They represent the results of an improved technic, and all have been checked up by a control which was not boiled with hydrochloric acid (Fig. 5). If this showed a crystalline deposit, and the one treated with hydrochloric acid did not, the test was regarded as negative.*

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* Presented before the Society of Clinical Surgery, Rochester, Minnesota, October 29 and 30, 1909.

Presented before the Kings County Medical Society, Brooklyn, New York, December 21, 1909.

Between March and October of this year there were tests made on 62 cases, which were operated and a diagnosis of pancreatitis made from the gross appearance of the gland. The lesions in related organs were also noted (Table I).

TABLE I.

Group	Diagnosis	No.	Pos.	Neg.
I.	Acute pancreatitis.			
II.	Subacute pancreatitis.			
	a. With obstruction of the common duct:			
	1. By stones in C. D. + H. D. + acute cholecystitis	1	1	0
	b. Without obstruction of the common duct:			
	1. Stones in G. B.	1	1	0
	2. Stones in G. B. + cystic duct	1	1	0
	3. Stones in G. B. + cholecystitis	1	1	0
	c. Infective	2	2	0
III.	Chronic pancreatitis.			
	a. With obstruction of the common duct:			
	1. By gall-stones	7	6	1
	2. By gall-stones + stones in G. B.	2	1	1
	3. By gall-stones + stones in G. B. + cystic duct	1	1	0
	4. By gall-stones + stones in G. B. + cholecystitis	1	1	0
	5. By growth	4	4	0
	b. Without obstruction of the common duct:			
	1. Gall-stones in G. B.	16	11	5
	2. Gall-stones in cystic duct	1	1	0
	c. Cholecystitis	7	4	3
	1. With stones in G. B.	6	5	1
	2. With pigment in G. B.	2	2	0
	3. With stone in C. D.	2	1	1
IV.	Atrophic pancreatitis	2	2	0
V.	Cancer of the pancreas	5	5	0
		62	50	12

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* The following notes on the technic of the pancreatic reaction (*ref.* Robson and Cammidge: The Pancreas, Its Surgery and Pathology) may be of interest. The albumin is easily precipitated out. Sugar, if present, is removed by fermentation, which may take 48 hours or more. After 24 hours, fresh yeast should be employed and a phenylhydrazin test for sugar by the v. Jaksch or Kowarski method made before the solution is carried through the pancreatic reaction. In some of the cases the elimination of all traces of sugar has been difficult, but must be accomplished if any value is to be ascribed to the results.

Of these 82 per cent. (50 cases) showed positive reactions in the urine, and the remaining 18 per cent. (12 cases) were negative. In the group of subacute cases (6) all were positive, while in the group of chronic pancreatitis (49) we had 77 per cent. of reactions. Both of the cases of atrophic conditions and all of the cancers (5) showed typical crystalline deposits.

It would be well to define some of the terms used in the summary, both of the classification of pancreatitis and of the accompanying conditions. While of course it is impossible to make an accurate classification merely from the gross appearance of the gland, the following has been adopted as a working basis. By acute, is indicated general enlargement, soft with hæmorrhagic tendencies; by subacute moderate general enlargement, firmer than the former and accompanied by fat necrosis; by atrophic very little remaining gland tissue, and that very soft; sclerotic denotes a small very dense gland with general involvement. Chronic pancreatitis is self-explanatory, and its two pathological types are the interacinar or large smooth gland with general involvement, and the

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In the second step, *i.e.*, adding lead carbonate, the hot hydrochloric acid solution should be perfectly cooled, as the reaction with the carbonate is violent if the solution is hot, and a film is formed on the sides of the beaker where reaction would not be complete; also that the resultant lead chloride is moderately soluble in hot solution. This reaction must be allowed to complete itself before filtering, usually three or four minutes.

The third step of adding tribasic lead acetate is an important one, as it serves to remove the glycuronic acid, which has been formed by boiling the urine with the hydrochloric acid (a mineral acid), if the specimen so treated contained glycuronates originally, which is frequently the case. The reaction should be allowed four minutes, being well shaken at half-minute intervals, the resultant filtrate should then be markedly decolorized and absolutely transparent.

The lead is then completely removed by precipitation as a sulphate, the solution having been rendered absolutely cool before filtration. Care must be taken that the neck of the bottle is cooled also.

All filter papers used should be washed with distilled water, and a small amount allowed to drain through in order to wash out the ever-present chlorides, which will precipitate the lead and cloud up the filtrate at certain stages.

interlobular or hard nodular gland, which is more apt to be localized.*

As it seems to have been shown that it is the disturbance of the internal secretion which bears the etiological relation to the production of the crystals in the urine, you are asked to bear this in mind as the observations are developed.

Of the 23 per cent. (12 cases) which gave negative reactions in the group of chronic pancreatitis, all were old standing cases, all were grossly of the interlobular type, and all but one localized in or near the head of the gland, the other being a general involvement; thus tending not to interfere markedly with the physiological action of the islands of Langerhans, either histologically because the islands are intralobular in situation, or with the one exception mentioned, because of being confined to relatively small areas.

It is also significant that in nine of the cases there was no obstruction of the common duct, five of them having stones in the gall-bladder only, the other four being complicated by cholecystitis, thus causing the pancreas the least irritation.

Is this irritation an etiological factor? Is it necessary that the stone be in contact with the gland in order to produce irritation? On the contrary, observations point to the other extreme. This is very noticeable in Group II. Here in six cases of subacute pancreatitis there was only one where there was obstruction by a common-duct stone, and that was complicated by an acute cholecystitis, and stones in the hepatic duct; and further in Group III among 49 cases of chronic pancreatitis there was obstruction of the common duct by stone in thirteen cases, or 27 per cent., and six of these were complicated by stones in the gall-bladder, cystic duct or cholecystitis.

It must be considered that interference with the hypothetical internal secretion of the pancreas, due to reflex irritation, may be the forerunner of pathological changes in the gland, either from stasis of the secretion or through its devitalizing effect predisposing to the subsequent infection.

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* While of course it is impossible to make an exact diagnosis of these two histological types without a histological examination, yet the glands grossly so resemble those on which histological examinations have been made that one would appear warranted in the above deductions.

What importance can be ascribed to the "pancreatic reaction" in this relation? There have been several cases where it has been positive, yet no gross change has been noted in the gland at operation; but the irritant factor (gall-stones or cholecystitis) having been removed, within two weeks after operation it has become persistently negative. While I appreciate the possibility that it may be due to a derangement of the liver that this substance is excreted in the urine (although many negative reactions and no positive ones have been obtained, where that organ was markedly involved, which would tend to eliminate this factor), may it not be assumed equally as well, if not more probably, that it was due to the reflex inhibition of the internal secretion causing a disturbance of the internal metabolism, correlated in cause and effect to the reflex stimuli noted so frequently in the stomach from gall-bladder or duodenal involvement, evidenced as a pylorospasm, hyperacidity or anacidity.

On the other hand, when the gross changes have occurred they may be so extensive as to have permanently injured the gland, and the internal secretion will be correspondingly insufficient. A few patients have returned for examination a year or so after operation, at which chronic pancreatitis was diagnosed, and have shown a positive reaction. They complain not of the original trouble, but of symptoms relevant to pancreatic derangement.

In 35 per cent. (20 cases) of this series, cholecystitis was present, introducing the infective factor. There are only a very few cases where infection is beyond doubt the only factor, and these are found in the group of subacute cases, and also in the instances of atrophic pancreatitis. In the entire series of 57 cases, excluding those of cancer (6), stones in the gall-bladder formed 49 per cent. (28 cases), while stone in the common duct *per se* and together with other factors formed 25 per cent. (14 cases); thus together we find stones in 74 per cent. of the cases.

In computing the percentages in the total number of cases of pancreatitis operated upon by Dr. Mayo, 293, excluding 28 cases of cancer (Table II), stones in the common duct occurred in 74 cases, or 25 per cent.; stones in the gall-bladder 151

TABLE II.—ETIOLOGICAL FACTORS IN PANCREATITIS.

Group	Diagnosis	Total
I.	Acute pancreatitis.	
	1. Stones in G. B.	4
	2. Stones in pancreatic duct	1
	3. Cholecystitis	2
II.	Subacute pancreatitis.	
	a. With obstruction of common duct:	
	1. Stone in C. D.	2
	2. Stone in C. D. + H. D. + Acute cholecystitis	1
	3 cholecystitis	4
	b. No obstruction of common duct:	
	1. Stones in G. B.	7
	2. Stones in G. B. + cystic duct	1
	3. Stones in G. B. + cholecystitis	12
	c. Cholecystitis	1
	d. Infective	2
III.	Chronic pancreatitis.	
	a. With obstruction of common duct:	
	1. By gall-stones	32
	2. By gall-stones + stones in G. B.	22
	3. By gall-stones + stones in G. B. + H. D.	8
	4. By gall-stones + stones in G. B. + cholecystitis	4
	5. By growth	9
	6. Infective	16
	7. Infective + stones in G. B.	2
	8. Stones in pancreatic duct	1
	b. No obstruction of common duct:	
	1. Gall-stones in G. B.	75
	2. Gall-stones in G. B. + cystic duct	4
	3. Gall-stones in G. B. + cystic duct + infection	1
	4. Sclerosis	4
	c. Cholecystitis:	
	1. With stones in G. B.	39
	2. With pigment in G. B.	6
	3. With stone in C. D.	5
IV.	Abscess of pancreas	3
V.	Cancer of the pancreas	25
	1. Stones in G. B.	3
VI.	Cyst of pancreas	1
		321

times, or 55 per cent., stones in one situation or another therefore being present in 77 per cent. of the cases. Cholecystitis was found in 98 cases, or 33 per cent., both as an independent factor and in conjunction with stones. These percentages correspond so strikingly with those in the smaller series (Table I) on which observations were made as to the presence or absence of the pancreatic reaction, that it would seem almost possible to transfer these results to the larger series.

From an anatomical point of view it is interesting to note that in 28 per cent. of the cases persistent jaundice was caused by the involvement of the common duct by the head of the gland. If to this is added the 25 per cent. representing the incidence of jaundice with stone in the ampulla, we would have 53 per cent., corresponding fairly closely with the 62 per cent. given by Helly in which he found the duct involved in the gland tissue in his cadaveric studies; but we are hardly warranted in disregarding the presence of the stone as the causative factor of the jaundice in all of the cases, although in some the pancreatitis was certainly caused because of the direct irritation of the stone on the surrounding gland substance, which probably accounts for the discrepancy in the percentages of incidence of gland involvement where only related portions of the biliary tract were affected, and where stone was found in the common duct, which is shown in the next observation.

In a series of 3095 operations by Dr. W. J. Mayo on the gall-bladder and biliary passages, pancreatitis was found in 293 cases, or 9.5 per cent.; approximately it occurred once in every 10 cases. In this same series there was obstruction of the common duct by stone in 394 instances, and an accompanying pancreatic in 74 of the cases, or 19 per cent.: approximately it occurred once in every five cases.

In order to find out further the degree of accuracy of this test, 50 consecutive cases were chosen in which clinically diverse affections of the biliary tract were diagnosed. Group

VI (Table III) shows what was found at operation. There were seven positive reactions obtained, or 14 per cent. In the majority of these positive cases there were many clinical signs that would lead one to believe that the pancreas might be involved, but no gross change was found at operation. It is to be noted, however, that these cases were of comparatively recent development, and it is quite possible that the hypothesis of irritation with resultant inhibition of the internal secretion indicates to us the *modus operandi,* and that this had not been in effect long enough to cause gross glandular change.

TABLE III.

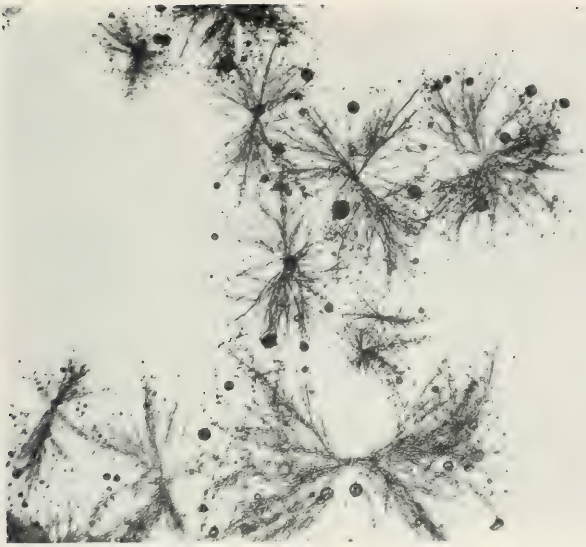
Group	Diagnosis	No.	Pos.	Neg.
VI.	No pancreatitis.			
	1. Gall-stones in C. D.	5	1	4
	2. Gall-stones in G. B.	17	2	15
	3. Gall-stones in G. B. + C. D.	5	2	3
	4. Gall-stones in G. B. + C. D. + H. D.	3	0	3
	5. Gall-stones in G. B. + cholecystitis	10	1	9
		50	7	43
VII.	Miscellaneous—no pancreatitis	50	3	47
VIII.	Normal	25	1	24

In Group VII, (Table III) there are fifty cases representing analyses on as many surgical conditions of the upper abdomen. The three positive reactions were obtained from two cases of carcinoma of the stomach, inoperable because of their extensive metastases, and from a very advanced cirrhosis of the liver in conjunction with Banti's disease.

In Group VIII (Table III) are twenty-five observations on the urine of persons apparently in normal health, only one of which was positive, and this reaction could not be obtained in a subsequent analysis.

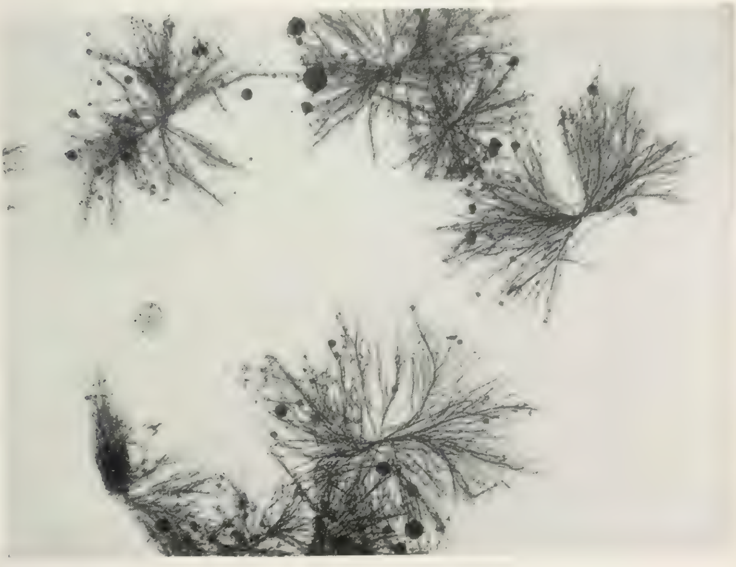
Heavy flocculent precipitates (Fig. 5) of typical crystals (Figs. 1 and 2) were noted to be rather indicative of general involvement, especially so in the group of subacute cases. While the more granular precipitates of the heavier broader crystals (Figs. 3 and 4) were found to occur more frequently in the instances of limited and moderate pancreatitis. These

FIG. 1.



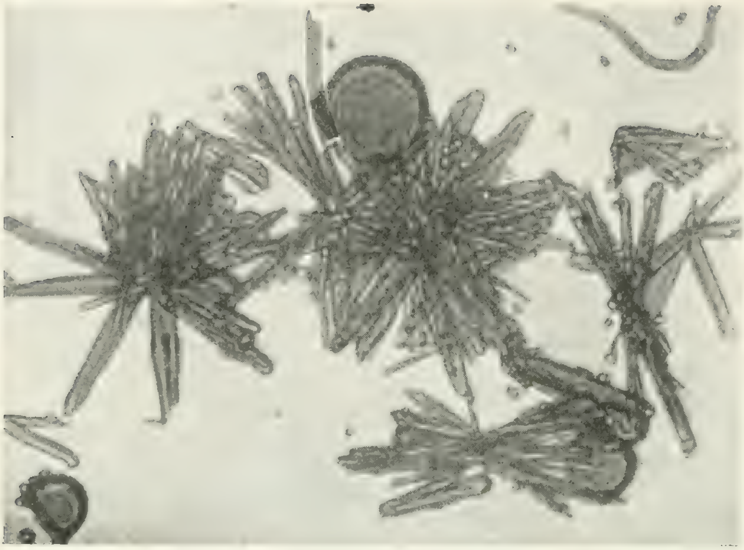
Typical crystalline deposits in case of general pancreatic involvement of interacinar type.

FIG. 2.



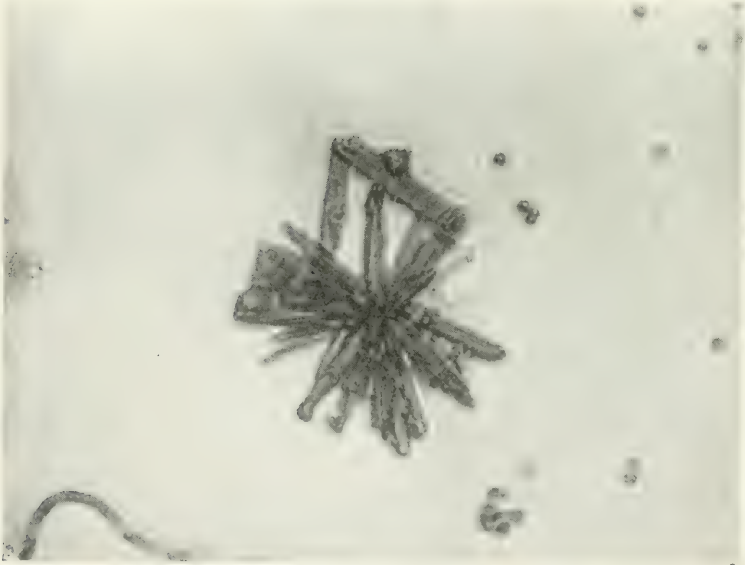
Typical hair-like or filiform crystals, showing sheaf formation in case of chronic pancreatitis with general involvement, of interlobular type.

Fig. 3.



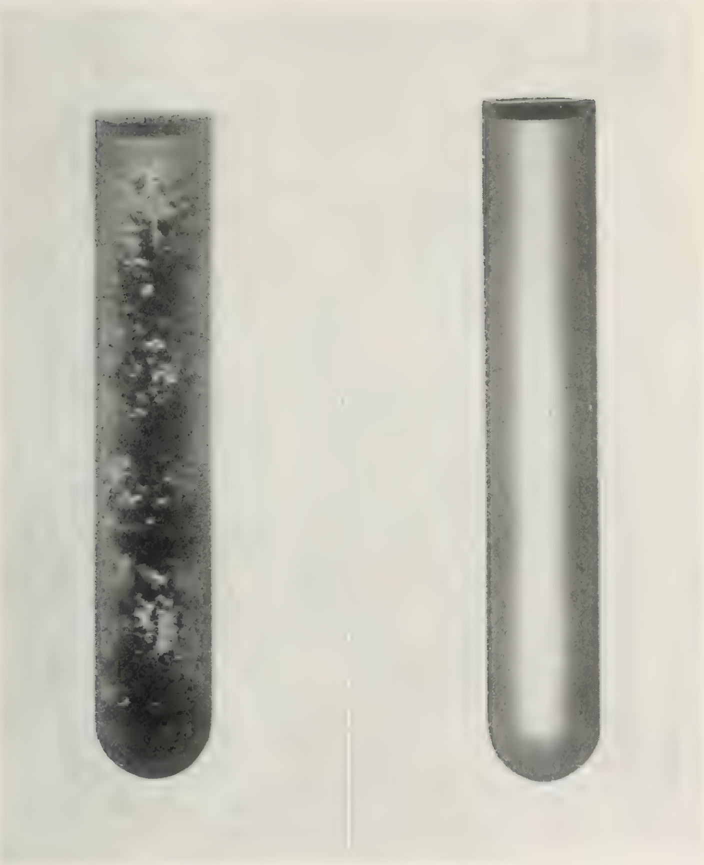
Acicular or saber type of crystals found in case of chronic pancreatitis with moderate involvement, of interlobular type.

Fig. 4.



Acicular crystal found in the heavy granular precipitates in cases of chronic pancreatitis with localized involvement.

FIG. 5.



Gross appearance of typical pancreatic reaction; heavy flocculent precipitate with a negative control.

observations are not by any means to be considered pathognomonic, and are suggestive only. Many hypotheses might be formed regarding the nature of the osazones forming these two types of crystals. Any statement of their structure must, owing to our present incomplete knowledge of the subject, be merely tentative. However, it seems that if investigations were pursued along the lines of the disturbance of the internal metabolism rather than attempting to account for the phenomenon through absorption of some substance from the gland itself, more progress could be made. The rapid disappearance of the reaction post-operative would seem to be fairly presumptive evidence that we have not to deal with simple absorption, as in that short period of time it is difficult to conceive of an entire regeneration of the pancreas, but rather with an incomplete catabolism in the blood.

EXPERIMENTAL DATA.

In order to determine whether the conclusions regarding the etiological factor played by the lack of internal pancreatic secretion both temporarily and permanently have more than a hypothetical basis for the production of these crystals in the urine, Dr. George Eusterman and myself undertook some dog experiments.

The dogs chosen were adult males, and in each instance were treated in one of the following four ways: (1) Segmental ligation, in which the gland substance was tightly constricted for its entire length at intervals of one and a half to two inches, the head and excretory ducts being left intact and patent; with the idea that there would be a temporary interference with the internal secretion and a permanent occlusion of the external secretion except that which could be obtained from the two inch segment containing the head and excretory ducts; and that the internal secretion would be renewed after the temporary sectional œdema had subsided. (2) Peripheral ligation; or the complete stoppage of all efferent and afferent vessels permanently, which was accomplished by throwing contiguous ligatures around the entire periphery of the gland, by which procedure the fact was expected to be established that it was not from any absorption of the gland substance but because of a lack of its internal secretion that the pancreatic reaction was obtained in the urine. (3) Partial extirpation; usually of the right half of the gland. (4) Total extirpation, by which it was desired to control the reactions obtained from peripheral ligation and eliminate the factor of fat splitting in the necrosed areas.

In Group I (Table IV) we find the reaction appearing between 24 and 48 hours and ceasing about the 96th hour, at which time we may assume the resumption of the internal secretion, after the subsidence of the local reaction. These dogs recover completely their normal health.

TABLE IV.—SYNOPSIS OF DOG EXPERIMENTS.

Group	Reaction ante operation	Reaction 24 hours post operation	Reaction 48 hours post operation	Reaction 72 hours post operation	Reaction 96 hours post operation	Reaction 120 hours post operation
I. Segmental ligation	—	—	+	—	—	—
	—	+	+	+	+	—
II. Peripheral ligation	—	+				
	—	+				
III. Partial extirpation	—	+	+	+	+	+
	—	—	+	+	+	+
IV. Total extirpation	—	+	+			
	—	+	+			

In Group II (Table IV) the reaction is exceedingly prompt, especially if the operation is done during the period of active absorption from the bowel, as is evidenced by the lymphatics being full of chyle, and it remains permanent to death, which occurs usually between the twenty-fourth and forty-eighth hour. Glycosuria intervenes in the interim, immediately, if the above-mentioned absorption is going on. Postmortem extensive and active fat necrosis is always found, being more marked the longer the dog lives, a few hours making a great difference. Careful examination has failed to reveal any rupture of the enveloping serous membrane by the gland, although it is very tense and swollen, which would tend to the deduction that the ferments escape into the free peritoneal cavity by transudation.

In Group III (Table IV) the reaction is liable to be delayed somewhat because of the secretion obtained from the uninjured one-half of the gland; but when once established is persistent until death, which occurs in from two to four weeks or longer from malnutrition. Toward the last, however, the dogs in this series refused to eat, and then only did the reaction fail. At postmortem the bowels were completely empty and the remaining portion of the gland enormously hypertrophied.

The results in Group IV (Table IV) are exactly comparable to those of Group II, except that the dogs lived a day or so longer, perhaps accounted for by the elimination of the toxic tryptic ferment. Proof that the fat necrosis was not the etiological factor is also hereby demonstrated.

Previous to each operation negative pancreatic reactions were obtained in every dog. The urines were all obtained uncontaminated, either by catheter or by being caught. The controls in every instance were negative. The typical stools and the rapid development of emaciation and languor have formed perfect clinical pictures when the animal lived long enough to develop this condition, as in Group III.

It would seem from these experiments outside of their value as corroborative evidence, that there is some abnormal substance excreted in the urine in cases of deranged internal secretion of the pancreas, that the gland proper is not absolutely essential to the well being of the dog, if its destruction is accomplished gradually, but that the internal secretion which seems to originate from the islands of Langerhans is most vital. It is not difficult to draw similar conclusions from an analogous condition in the human, namely in cases of atrophic pancreatitis; here the gland tissue is practically nil, but the islands of Langerhans seem to be intact if one might judge clinically, for the excretion of the substance giving the pancreatic reaction is certainly stopped after elimination of the irritant factor by operation, the patients recovering in a very short time a condition of health which they had not enjoyed for many months.

The most plausible explanation why these bodies which secrete their as yet hypothetical product internally are not destroyed at the same time as the remainder of the gland, is that they receive an entirely different nerve supply from the sympathetic, and for the same reason it might be inferred that their secretion would be more liable to be disturbed by either direct or reflex irritation.

These observations certainly seem to illustrate rather aptly the remarks of Dr. W. J. Mayo to the effect that " the surgeon cannot intelligently operate upon organs of double function without a full knowledge of their internal as well as their external secretions, for therein may lie the cause of the failure of a mechanically well executed operation to cure the patient."

Conclusions.—While the above experiments and observations are of course too few to be considered final, the following conclusions may be tentatively made. Briefly the appended data indicates the premises and the deductions.

1. There is some substance excreted in the urine in cases of pancreatic irritation, as shown by the pancreatic reaction (dog and man).

2. The external secretion is not responsible for it (dog).

3. Therefore there must be an internal secretion (dog).

4. Interference with its production causing therefore a disturbance of the internal metabolism (dog).

5. The catabolism in the blood not being complete the substances are excreted as foreign bodies in the urine (dog).

6. In atrophic pancreatitis the pancreatic reaction is positive before operation (man).

7. At operation the irritant or etiological factor of the condition is removed (man).

8. After operation the pancreatic reaction disappears within a few days (man).

9. In a few days the pancreas is incapable of completely regenerating itself (man).

10. Therefore the same conclusions seem warranted in the human as were reached in the dog (*ref.* 3, 4 and 5).

11. That the internal secretion is produced by the islands of Langerhans, or some other pancreatic structure (man and dog).

12. That while the pancreas proper may be greatly degenerated these islands probably remain intact (man and dog).

13. That when there is no irritation these islands continue to secrete and no pancreatic reaction is found (man).

14. That irritation causes inhibition of the secreting properties of these islands, evidenced by the pancreatic reaction (man).

15. That removal of this irritation allows the patient to recover health (man).

16. Therefore the external secretion of the pancreatic gland is not more essential to either human or dog than the internal secretion.

Analytical.—1. In 62 cases of pancreatitis the urinary reaction was positive in 82 per cent. and negative in 18 per cent.

2. Positive reactions were obtained in all cases of subacute and all of the more marked chronic types of pancreatitis.

3. The negative results were obtained in cases of moderate localized chronic pancreatitis of interlobular type.

Statistical.—1. 293 cases of pancreatitis, stones were present in 77 per cent.; 52 per cent. in the gall-bladder and 25 per cent. in the common duct. Cholecystitis was marked in 33 per cent., *per se* and plus other factors.

2. In 3095 operations on the gall-bladder and biliary tract 9.5 per cent. of the cases were accompanied by gross changes in the pancreas. In 394 operations in which stone was found in the common duct 19 per cent. were accompanied by gross changes in the pancreas.

Inferential.—1. The disturbance of internal secretion of the pancreas is responsible for the pancreatic reaction; that this may be effected by reflex irritation as well as by direct, which may prove the forerunner of gross changes in the gland.

2. A typically positive reaction with a negative control is almost pathognomonic of pancreatic derangement. The converse is not shown.

My thanks are due to Dr. W. J. Mayo for suggesting the above study and placing at my disposal his clinical material; to Dr. L. B. Wilson, Director of the Pathological Laboratory, for his advice and personal interest, and to Dr. George Eusterman for his valuable assistance in the experimental work.

PARALYTIC ILEUS AS A SEQUEL OF FRACTURED RIBS.

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THE rarity of this condition, and its importance when it does arise, combine to make the following cases worthy of interest. The facts set forth may also afford some addition to our knowledge of the neuromuscular mechanism of peristalsis of the small intestine. That this is mainly influenced by its own peculiar nervous system contained in Auerbach's and Meissner's plexuses has long been known, and the fact that the vagus contains accelerator, and the splanchnic nerves inhibitory fibres, which are capable of influencing peristalsis to a marked degree, is also recognized. The results of their investigation into the mechanism of peristalsis, and the influence of vagal and sympathetic nerves on the movements of the small intestine, were published by Bayliss and Starling * in 1899, and the effects of stimulation of the splanchnics were summed up by Starling † as follows: " Stimulation of the splanchnic causes complete relaxation of the lower part of the ileum with the rest of the small bowel, but it produces a strong contraction of the muscle fibres forming the ileocolic sphincter." We have thus conditions favorable for the production of the clinical signs of small intestine obstruction, and it remains to be seen whether the following cases can be explained on the theory of splanchnic irritation and stimulation.

The two cases here described were both admitted to St. Thomas's Hospital under the care of Mr. H. Betham Robinson, and I am indebted to him for permission to publish them.

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* Journal of Physiology, xxiv, 1899.

† Recent Advances in the Physiology of Digestion, 1906.

Case I. (Fatal.)—G. V., male, æt. 66, interpreter.

Previous History.—With the exception of having passed blood *per rectum* on two or three occasions the patient's health had been excellent.

History of Present Illness.—Three days before admission to the hospital, on June 19, 1907, the patient fell against some banisters and fractured several ribs on his right side. The affected side was efficiently strapped by his general practitioner, who saw the man once or twice again after the accident. Before the fall the patient's bowels had acted with regularity, but after it they refused to act, although aperients and three enemata were administered. Vomiting set in on the day of admission, and at first the vomit was bilious in character, but as its frequency increased the color had been observed to become darker,—so that when admitted the patient was bringing up black vomit. There was slight abdominal pain.

Examination.—The patient was a healthy looking man with excess of fat all over the body. His tongue was very dry, pulse rate 120, respirations 40, temperature 99.6° F. The abdomen was generally distended, but the distention was more noticeable centrally than in the flanks. There was no visible peristalsis. On percussion a tympanitic note was obtained all over the abdomen with no trace of dulness in the flanks; the liver dulness was diminished. There was some tenderness caused by pressure in the region of the left iliac fossa. Rectal examination negative. There was evidence of fracture of several ribs on the right side of the chest, as shown by marked local tenderness over the lower four ribs close to their angles. The situation of the tenderness was also sharply defined when pressure was applied on the anterior extremities of the ribs. No crepitus, however, could be detected. There was no evidence of lesion of lung or pleura on either side. A diagnosis of intestinal obstruction was made, and, although there was little but the local left-sided tenderness to warrant it, the primary lesion was thought to be a carcinoma of the iliac colon.

Operation.—Performed shortly after admission, under chloroform anæsthesia. The abdomen was opened through the right rectus, but no lesion save distended bowel could be discovered; the distention chiefly affected the small bowel, and the cæcum and colon were only moderately dilated. There was no free fluid and the distended coils of small intestine prevented complete examination of the descending colon. A left-sided incision was therefore made, but no further lesion could be discovered except a slight abnormality in the attachment of the mesosigmoid. That this in no way accounted for the obstruction was clear from the fact that the descending colon was not distended. The absence of any cause for obstruction in the rectum or pelvic colon was further demonstrated by the passage of a rectal tube which was easily felt through the abdominal wound in the lumen of the bowel after it had passed 8 to 9 inches from the anus. A little gas and fecal matter escaped. As no sign of organic obstruction could be discovered the abdominal cavity was closed in layers.

After the operation the patient showed signs of profound shock, and, while the abdominal distention was markedly decreased, his general condition was far from satisfactory. The stomach contents were vomited and the man complained of abdominal pain; there were no signs of peritonitis, but there was marked thirst,—the tongue became very dry, and the patient's mental condition was abnormal. Turpentine enemata were administered but these yielded no result, and were in fact retained, showing that the large bowel would not respond to the ordinary stimulus of fluid distention. Ten ounces of hydrogen peroxide (10 volumes per cent.) were then used as an enema, and this, which caused more sudden stimulation of the bowel, produced an evacuation of flatus and fecal matter, and the patient expressed his relief. However, mental depression was still a marked feature of the man's condition, and he stated that he was about to die, which in fact he did, although his vomiting had ceased and a satisfactory action of the bowels had been obtained, some 48 hours after operation.

Post-mortem examination, by Dr. W. O. Meek. The small bowel was greatly distended and so also was the cæcum, while the colon was collapsed. The pelvic colon had a mesentery which was more vertical than usual in its attachment to the posterior abdominal wall. There was no obstruction to the lumen of the bowel and no hypertrophy of the muscular coat. There was excess of abdominal fat. The peritoneum was healthy. The eighth to the eleventh ribs on the right side exhibited ununited fractures in the region of their angles; there was little callous formation. The pleuræ and pericardium were healthy. The heart was pale and flabby, the valves healthy. Lungs emphysematous and congested at the bases. The remaining organs exhibited no noticeable lesion, and there was no trace of a hernial sac in any of the usual situations.

That the condition might be due to what has been termed "angulation of the sigmoid" occurred to me during the course of the operation, but the absence of distention of the colon negatived the possibility of this explanation. The case thus appears to have been one of paralytic distention going on to the production of acute intestinal obstruction and causing death from toxæmia.

Case II. (Recovery.)—J. C., male, æt. 60, bricklayer.

History.—On the day of admission, August 12, 1908, the patient, who was a fat bronchitic subject, fell from a ladder a distance of 18 feet, on to some sacks of cement, thereby fracturing the eighth and ninth ribs, close to their angles, on his right side, and causing severe contusions to his back. There was no evidence of hæmothorax or other lesions.

He was placed in bed and treated for h [illegible] torants, with a steam-kettle by the bedside. [illegible] ing was somewhat labored and his color w [illegible] four hours after admission he stated that [illegible] easier, and there was slight mucopurulent expectoration. There were rhonci and a few crepitations heard over both lungs. However, on the third day it was observed that the man's abdomen was unduly distended, and his respirations, which were 32 per minute, were more labored than ever, and his general condition was not so good as it had been. Two turpentine enemata were given to relieve the distention, but these were returned, and the patient passed only a little flatus with a very little fecal matter. The bowels had not acted since admission. On the fourth day it became clear that active measures must be taken to relieve the abdominal distention and lessen the respiratory embarrassment. There was at this time extreme central distention of the abdomen, with a tympanitic note on percussion over it; no sign of free fluid in the flanks; tongue dry; anxious facial expression; rapid and feeble pulse. The patient was greatly distressed by hiccough and once or twice he vomited stomach contents. There did not appear to be any distention of the colon, and there was no visible or audible peristalsis; rectal examination revealed no cause for obstruction.

The clinical picture was one of intestinal obstruction, and as enemata and the passage of a long rectal tube had afforded no relief, some operative measure was clearly called for. The man was in no condition for the administration of an anæsthetic as he was markedly cyanosed and his pulse was rapid and feeble. It was decided to try the effect of puncturing the bowel through the abdominal wall with a hollow needle. This was effected at the site of the greatest distention—in the middle line, above the umbilicus—with a small exploring needle. A quantity of gas escaped and a little fluid fecal matter was ejected; the size of the abdomen was greatly lessened, and the patient experienced a sense of great relief, and said that he was almost comfortable. This treatment was followed up by the injection of eserine salicylate gr. 1–50 into the buttock at four-hourly intervals. After two doses the bowels acted twice and the man was greatly relieved. This improvement, however, only lasted for about sixteen hours, and at the end of this time his condition was as bad as before,—so that a more permanent method of relieving the distention of the small bowel became imperative. In the same situation as that selected for puncture an incision was made under local infiltration anæsthesia, and a coil of small intestine, blown up firmly against the parietal peritoneum, was exposed. Owing to the taut condition of the bowel wall even the smallest Paul's tube could not be sutured in position, so a very small opening was made and a winged rubber catheter was tied into the bowel. A few stitches were put in to hold the bowel and the parietal peritoneum in contact. Gas and fecal matter escaped, and, as the latter tended to block up the tube, this was filled with water, and by means of syphonage, a good deal of both fluid fecal matter and gas were evacuated. This relief of the distended bowel again allowed the muscular coats of the bowel to contract, and peristalsis recommenced, causing an evacuation *per rectum* three times in the succeeding 24 hours. The production of this small fecal fistula to all appearances saved the patient's life, and it seems clear that the same procedure should have been adopted in Case I.

Both gas and fecal matter continued to escape for about three weeks, after which time there was only an occasional whistling of gas through the wound, and the latter eventually closed firmly at the end of the eighth week. Two days after the operation the patient was comfortable and his abdomen was of normal size. No eserine was administered after the second operation. It was not possible to tell which part of the small bowel was opened.

If due consideration be paid to the history of these two cases and the clinical phenomena which they presented, the conclusion at which one arrives, I think, is that both patients were suffering from paralysis of the small bowel, and, as to the cause of this, I have suggested above that it may have been due to splanchnic irritation. Starling states that every part of the small intestine receives fibres indiscriminately from the splanchnics of both sides, and that the stimulation of this nerve on either side produces the same effect, namely, inhibition of peristalsis. He further states that such paralysis of the gut has occurred in cases of gunshot wounds of the abdomen, probably from splanchnic irritation and stimulation, unaccompanied by injury to the intestine itself. It is true that the fracture of the ribs in both these cases was situated in the neighborhood of their angles [illegible] ganglia from which the splanchnics ar [illegible] of the ribs; but it may reasonably be [illegible] placement of the proximal fragments occurred, sufficient to irritate the sympathetic chain, either directly, or through the rami communicantes connecting the sympathetic ganglia with the spinal nerves. In both cases the great splanchnic nerve of the right side would be the one involved, as this arises from the sixth to the tenth thoracic ganglia, and in one case the eighth and ninth ribs were broken, and in the other the eighth to the eleventh. In one case, it is true, the patient fell a distance of 18 feet, and this may have caused a severe abdominal contusion or concussion, and, experimentally, if both splanchnic nerves be intact a blow on the bowel will cause inhibition of its muscular coats all along the length of the intestine,—and herein may lie the true explanation of the beginning of a condition which finally terminated in paralytic obstruction. Paralytic distention of the small bowel is fairly commonly met with after operations for strangulated hernia, resections of bowel, and other operative procedures, and the initial stagnation of the bowel contents leads the way to actual obstruction if no relief is afforded. The sequence of events in such cases is amply illustrated by my second case. Here the peristaltic paralysis favored the accumulation of gas from putrefactive changes in the small bowel, probably the ileum, for here the bacteria are more numerous than in the jejunum, and the over distention made it still further impossible for the bowel to contract even had it recovered from splanchnic irritation and inhibition. In both cases the extreme gravity of the condition was not apparent until the third day after the accident, and during the interval between the cause and the very serious effect, gas from putrefaction had been generated within the lumen of the bowel.

The paralyzing effect of abnormal distention is well shown in acute dilatation of the stomach, where vomiting occurs at the onset of the condition but frequently ceases as the distention progresses,—and this accounts for the fact that the clinician may easily overlook the lesion unless he makes a repeated and careful abdominal examination. In the case of the stomach, emptying the organ by lavage will effect a cure if the condition be recognized early,—and so, in my second case, giving vent to the distending gas in the small intestine by puncture with a hollow needle, not only relieved the patient from his respiratory embarrassment for sixteen hours, but favored peristalsis to such an extent that two actions of the bowels rapidly ensued. The administration of two doses of eserine salicylate gr. 1–50 into the buttock did undoubtedly help in producing this peristaltic action; but that it was not the main factor in producing it is suggested by the fact that the drug was not used again after the small ileostomy opening had been made at the second operation. The risks of thus puncturing the bowel through the abdominal wall, when in a state of extreme distention, do not appear to be very great, as a return to the high intra-intestinal pressure did not cause any further leakage of contents, and, when the needle was withdrawn its track must have closed immediately. The type of needle used was just such as one is accustomed to use in the search for pus in a case of suspected empyema.

The good effect of this intestinal puncture was only temporary; re-accumulation of gas caused a return to the high intra-intestinal pressure against which the muscular power of the bowel wall was powerless, and it is clear that such a condition is not amenable to treatment by aperients or enemata. The former act either on the musculature of the bowel wall—which is too heavily handicapped to be able to respond—or on the glandular layers, increasing the fluid in the intestine,—and this is not likely to help in the discharge of this fluid if the muscle be paralyzed; enemata act mainly on the large bowel, and only secondarily on the contractile power of the small intestine: and this accounts for the fact that success with enemata in cases of peritonitis is no criterion of a favorable prognosis.

The operation of ileostomy is one which surgeons hesitate to perform for several reasons, even in cases of paralytic obstruction. First, on account of the grave condition of the patients in whom it is likely to be required; secondly, because, if the opening be made high up in the small intestine, the patient may go down hill from inanition before the bowel can be closed, this second operation being often delayed on account of the soreness and autodigestion of the tissue around the artificial opening. These objections, I think, hold in cases of paralytic ileus only where a general anæsthetic is used, and where some such apparatus as a Paul's tube is used to effect the opening into the bowel.

Now, if the opening we propose to make in the bowel be small there can be little objection to an incision in the middle line, and local anæsthesia by infiltration or any other method will certainly suffice for the operation. The incision should be close to the umbilicus, for it is here that the distended coils of ileum are usually situated in such cases, and the risks of subsequent hernia are less above than below the umbilicus. The visceral peritoneum will be found to be insensitive and a purse-string suture can easily be placed in position and a winged rubber catheter of about size No. 12 can be secured; a few seromuscular sutures may then be put through the slackened bowel and the parietal peritoneum. This procedure succeeded admirably in my case, and in view of the fact that the contents of the bowel are gas and very fluid fæces I see no reason to need a larger opening.

The relief required to overcome this state of paralysis is only temporary, and the main object of the operation is to provide for the safe exit of the imprisoned gas. If peristalsis is re-established the intestinal contents will find the normal route easier than that through the catheter, so that there is very little likelihood of the opening failing to close spontaneously if the catheter be removed after a few days. If the tube should become blocked with fecal matter, syphonage with water will usually clear it. It may be that I was fortunate in the case described above in placing the catheter in the right portion of the bowel; but if one such aperture failed, I see no objection to a second, made under similar conditions, the safety of the procedure resting on the fact that if only a small opening be made in the bowel wall there will be a rush of gas and not of fæces, as that portion of the gut close to the parietal peritoneum is sure to be blown up against the abdominal wall with flatus, and the catheter can be secured in position before any fecal matter is ejected.

Performed on these lines I feel convinced that ileostomy should more often be performed than it is for the relief of paralytic distention of the bowel, whatever the primary cause of this condition may be, whether peritonitis be present or not. Such an opening as this will, as a rule, close spontaneously, but if not, the closure of so small a fecal fistula should not be a matter of any difficulty as soon as the condition of the patient warrants a further operation.

FIBRINOUS CALCULI IN THE KIDNEY.

BY HOMER GAGE, M.D.,
AND
HOWARD W. BEAL, M.D.,
OF WORCESTER, MASS.

IN the ANNALS OF SURGERY for September, 1908, we reported a case under the above title, with some references to the literature of the subject. Since then the patient has died, and the results of the postmortem examination, especially so far as they relate to the condition of the genito-urinary tract, seem of sufficient interest to warrant a brief record. The kidney was removed June 1, 1906. In January, 1908 the patient had influenza, in February tonsillitis, and on March 12, 1908 she entered the hospital with a diagnosis of pleurisy, remaining until April 4. She returned to the hospital September 23: at that time she had pain in the left hypochondrium with constant nausea, vomiting and much diarrhœa. She died October 18. The following is an extract from the autopsy record:

Body length 5 ft. 6 in. Estimated weight 120 pounds. Color of skin sallow, suggesting bronzing. *Rigor mortis* present. Scattered over the body everywhere are minute punctate hæmorrhagic areas. Slight œdema of both limbs. A large cicatrix at base of toes on dorsum of left foot; another cicatrix just below middle of right leg on inner side, 5/8 x 3/8 inches. Abdominal fat is 1 inch in thickness. Omentum bound firmly to top of bladder along edge of right rectus (stomach bound to scar from gall-bladder operation). Foramen of Winslow obliterated. Stomach adherent to pancreas.

Appendix normal.

Kidney.—Peritoneum thickened and fibrous over kidney. Left ureter apparently normal. Right ureter (much enlarged) full of hard material. On section kidney shows infarcts—slight pyelitis.

Heart dilated; muscle soft and light colored. Left ventricle much dilated, contained clots. Partly organized thrombi.

Lungs.—Œdematous.

Liver.—Moderate nutmeg liver.

Arteries.—Moderate general arteriosclerosis. Thrombosis of left renal artery.

Bladder.—Full, apparently normal.

Anatomical Diagnosis.—General arteriosclerosis; myocarditis; dilated heart; general abdominal adhesions; renal infarcts.

The vagina, bladder, uterus, both ureters and the remaining kidney were removed in one piece and sent to Dr. Thomas Ordway of the laboratory of the Boston City Hospital, from whom the following report was received:

"Specimen received (see Fig. 1) consists of female genitalia and bladder to which, on the left, a considerably enlarged kidney containing numerous infarcts is attached by the left ureter and left ovarian vein. These appear normal. On the right, the kidney is absent and the proximal portion of the ureter is fastened to a small mass of skin and subcutaneous tissue. The right ureter is irregularly and markedly thickened, particularly in the middle portion. (Fig. 1.)

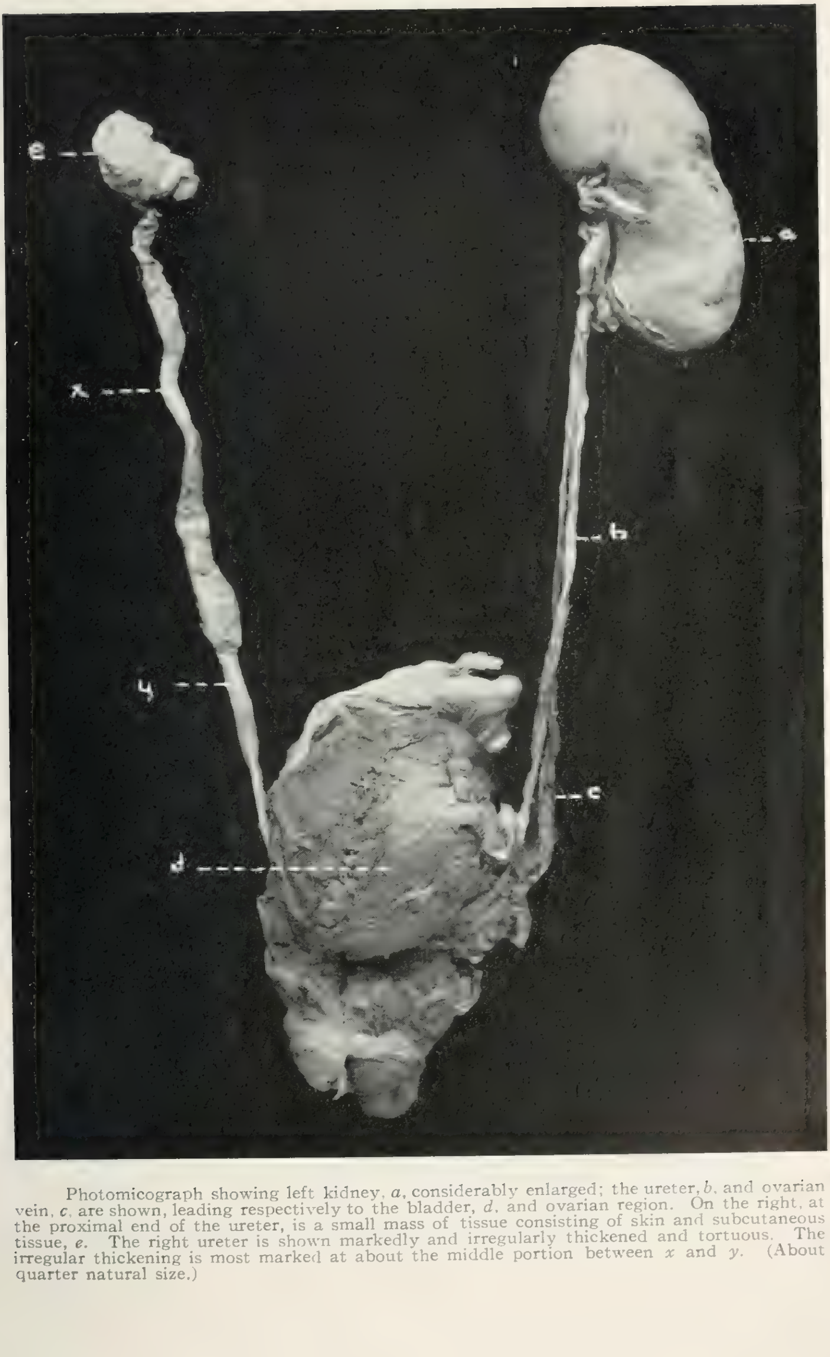
"The thickened portion of the right ureter (see Fig. 2) has an irregular, nodular appearance and firm consistence. It is covered with numerous fibrous tags. Above and below the thickened portion the ureter is of more normal size.

"On opening the ureter it is found distended with numerous masses of very friable material which easily falls to pieces, giving it a distinctly granular appearance (Fig. 3)."

"A portion of the ureter and contents (Fig. 3) was taken for microscopical examination. The wall of the ureter and the enclosed concretion were embedded in celloidin, then put into acid alcohol for a short time, as concretion contained a few spicules of gritty material. The portion remaining on the block after sectioning was photographed in gross under alcohol (Fig. 4). The thickened wall of the ureter is shown and the concentric markings of the concretion are evident. Microscopical sections show marked chronic inflammation of the ureter (Fig. 5, *a*). The concretion is made up of concentric laminæ composed of fibrin in the form of threads and network, in the meshes of which are many polymorphonuclear leucocytes and lymphoid cells."

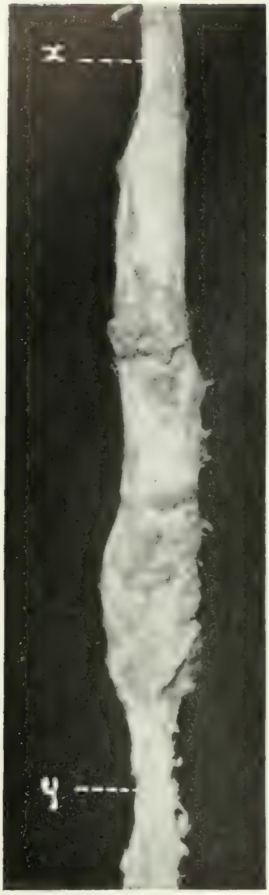
The result of an additional diagnosis (microscopical), was: "Multiple fibrinous concretions in ureter. Chronic ureteritis."

Fig. 1.



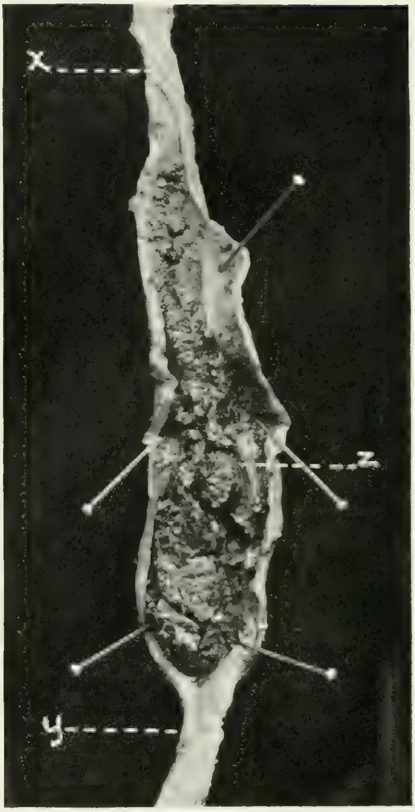
Photomicograph showing left kidney, *a*, considerably enlarged; the ureter, *b*, and ovarian vein, *c*, are shown, leading respectively to the bladder, *d*, and ovarian region. On the right, at the proximal end of the ureter, is a small mass of tissue consisting of skin and subcutaneous tissue, *e*. The right ureter is shown markedly and irregularly thickened and tortuous. The irregular thickening is most marked at about the middle portion between *x* and *y*. (About quarter natural size.)

FIG. 2.



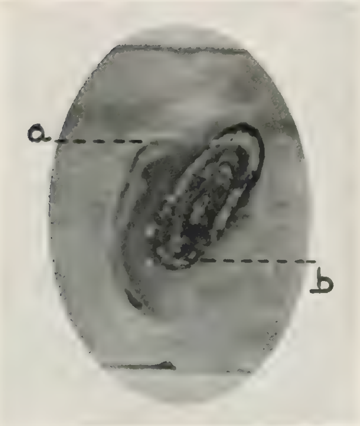
A detail of Fig. 1 from *x* to *y*, showing thickened portion of right ureter having an irregular, nodular appearance and covered with numerous fibrous tags. Above and below the thickened portion the ureter is of normal size. (Magnified one and one-quarter times.)

FIG. 3.



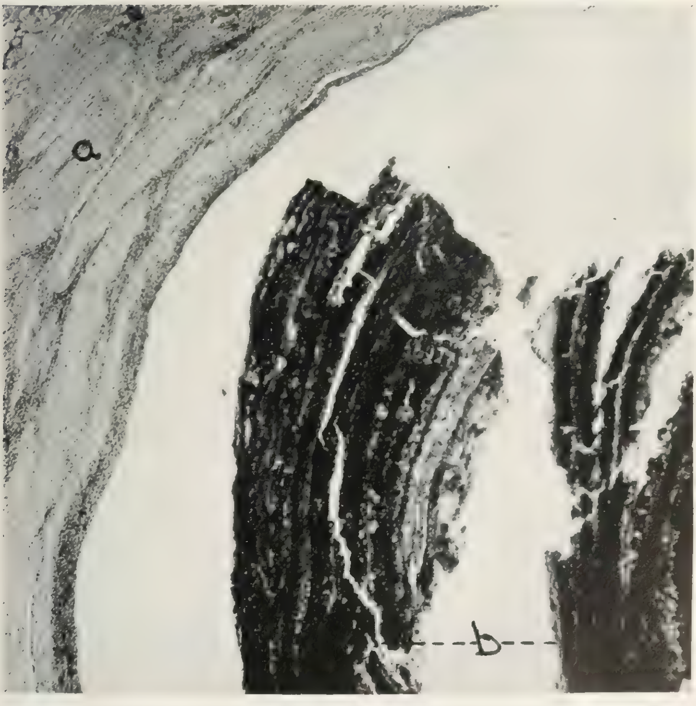
Enlarged portion of right ureter opened longitudinally, showing the lumen filled with nodules and masses of friable material. (Magnified one and one-quarter times.)

Fig. 4.



Cross-section at *z*, Fig. 3, showing portion of wall of ureter, *a*, and enclosed concretion, *b*, the concentric markings of which may be seen.

Fig. 5.



Microscopic section from "block" shown in Fig. 4. Wall of ureter showing chronic inflammation is seen above and to the left of the dark, laminated mass which represents the fibrinous concretion.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY.

Stated Meeting, October 13, 1909.

The President, Dr. Joseph A. Blake, in the Chair.

UMBILICAL CORD HERNIA: OPERATION ELEVEN HOURS AFTER BIRTH.

Dr. William A. Downes presented an infant, five weeks old, which was brought to the Babies' Hospital on September 7, 1909, a few hours after birth. Examination showed a congenital umbilical cord hernia, about the size of a child's head.

Operation was done eleven hours after birth. The child was given a whiff of ether, and the thin sac, which was composed of amnion and a peritoneal lining, was incised at the junction of the sac with the abdominal wall. The sac was filled with small intestines surrounded by clear serum, and upon evacuating this the small intestines were easily reduced. There was no Wharton's jelly between the layers of the sac. There were no fistulous tracts nor adhesions. The child made an uneventful recovery.

In connection with this case, Dr. Downes showed the sac, which had been excised, and also photographs of the child before and after operation (Figs. 1 and 2).

Dr. Howard Lilienthal asked Dr. Downes what proportion of these cases recovered? This was the first case of this congenital form of hernia that he had ever heard of to get well. Usually, the contents of the hernial sac were such that they could not be returned into the abdominal cavity. In a case that he saw at Mt. Sinai Hospital about a week ago the child promptly died after operation.

Dr. Downes said he had found the history of two cases that had been seen at the Hospital for the Ruptured and Crippled. One of these was operated on by Dr. William B. Coley about 23 hours after birth, and recovered. In that instance the peritoneal cavity was not entered, the contents were reduced and the edges of the skin at base of sac freshened and brought together over sac. The other case was moribund when it was brought to the hospital.

One writer, Dr. Downes said, had reported over 90 cases, in which laparotomy had been performed with 65 recoveries. In many of these cases the hernial sac contains the liver or other abdominal viscera, and this makes the outlook very unfavorable.

TUBERCULOUS CHONDRITIS AND MASTITIS SIMULATING CANCER.

Dr. Alfred S. Taylor presented a woman, 22 years old, who in 1904 had an abscess in the left axilla which was said to be tuberculous.

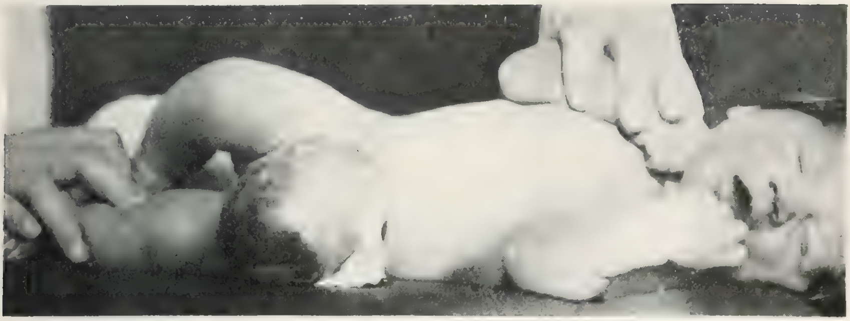
Following this she remained in good health until January, 1908, when she received a contusion of the right breast which about two months later began to give her considerable pain, and on rubbing the breast she happened to notice a lump within it.

When Dr. Taylor first saw the patient, in June, 1908, she had a tumor along the lower border of the right breast which had many of the characteristics of carcinoma. It was perceptible to the eye, hard, nodular and infiltrating. It was quite firmly fixed to the underlying structures, but not adherent to the overlying skin. There was no tenderness and no palpable enlargement of the axillary glands. The general characteristics of the growth were very suggestive of carcinoma.

Against the diagnosis of carcinoma was the unusual site of the tumor, at the lower edge of the breast in the nipple line, the fixation to the deeper structures without involvement of the skin, and the absence of axillary involvement.

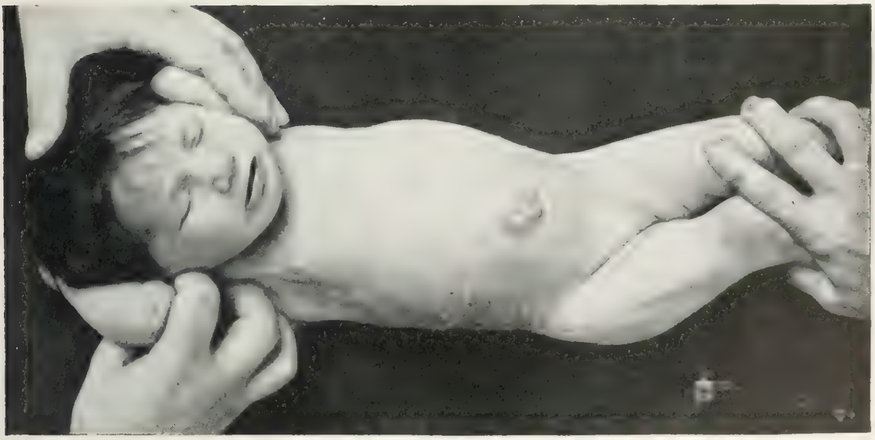
When under ether, a trocar and cannula was inserted into the tumor, but no fluid was withdrawn. After the withdrawal of the needle a few drops of creamy pus exuded from the skin puncture, thus establishing a diagnosis of non-malignancy. A circumferential incision was then made and the breast turned upwards, disclosing a tuberculous mass with thickly infiltrating walls. The cartilage of the sixth rib and a portion of the adjacent rib were involved in the tuberculous process and were resected. The pleura was apparently not involved. Upon resecting a part

Fig. 1.



Large umbilical hernia containing almost entire small intestine. Ten hours after birth.

Fig. 2.



Four weeks after operation.

of the muscle it was found that the tuberculous process had worked its way into the posterior portion of the breast. This was resected, and the rest of the breast tissue was then brought together with catgut sutures. The muscular tissues were sutured over the defect in the ribs and cartilage.

The patient made a practically uneventful recovery, and since the operation, which was done over sixteen months ago, she had had no further trouble. There was no resulting deformity of the breast.

HAIRPIN IN MALE BLADDER REMOVED BY THE AID OF A CYSTOSCOPE.

Dr. Howard Lilienthal presented a man, 55 years old, who had taken one of his wife's hairpins and inserted it into his urethra for the purpose of relieving an irritation of the canal. The pin accidentally got beyond his reach and disappeared in the urethra. He consulted his physician, Dr. Cereseto, who was able to introduce a catheter into the bladder, and when Dr. Lilienthal saw the patient, about 24 hours later, a full-sized sound could enter the bladder without any difficulty. It was thereupon concluded that the hairpin had passed into the bladder, and cystoscopy was proposed.

With the aid of the cystoscope, the hairpin was immediately located. The forceps that was devised by Dr. Follen Cabot for the removal of small foreign bodies from the bladder was then introduced through the cystoscope, and with it the pin was seized at a point about half way between an extremity and the bend. Fortunately, it was made of very thin, corrugated wire, and no difficulty was experienced in drawing it into the cystoscope and extracting it. The entire procedure occupied but a very few minutes. There was no reaction whatever and the patient is well.

INTESTINAL OBSTRUCTION FOLLOWING OPERATION FOR APPENDICITIS.

Dr. Lilienthal presented a young man who, after several attacks of appendicitis of moderate severity, was operated on in July, 1909, and the appendix removed. In his last attack a mass was felt far to the outer side, close to Poupart's ligament. Instead of making the usual transrectus incision, Dr. Lilienthal said he made his incision directly over the mass, and in removing the appendix through that opening it was necessary to open the general peritoneal cavity. The wound was closed, with drainage, and an uneventful convalescence was expected.

On the day following the operation the patient complained of cramps, which persisted. Flatus was passed, but there was no satisfactory movement of the bowels. On account of these symptoms, but largely because of the patient's suggestive *facies,* the abdomen was reopened on the fourth day through a transrectus incision which revealed an enormous coil of obstructed ileum, one leg of which had prolapsed into the abscess cavity, producing complete obstruction. A large amount of gas and liquid fæces was evacuated, and the patient made a good recovery without the necessity of resorting to an enterostomy.

In connection with this case, Dr. Lilienthal showed an instrument which he had used to great advantage in this and similar cases. By means of this instrument the over-distended gut could be punctured and its contents evacuated in an absolutely clean and effective manner.

The speaker also emphasized his belief that in cases where there was any doubt as to the permeability of the bowel after an operation for appendicitis, especially in the presence of abscess, a secondary exploratory operation should be done sooner than was now usually the case. In a second similar case that recently came under his observation the abdomen was reopened and an almost identical condition was found, excepting that the entire small intestine was tremendously distended, and an obstruction was traced to a kink at the site of the abscess cavity.

RUPTURE OF A POLYCYSTIC KIDNEY.

DR. ALEXANDER B. JOHNSON presented a man, 34 years old, who entered Dr. Johnson's service in the New York Hospital on May 16, 1909, with the following history:

He had enjoyed throughout his life reasonably good health, and had never suffered from any symptoms referable to his genito-urinary tract. During the past few years he had had from time to time attacks of pain referred to the epigastrium, for which he had consulted several physicians, who had made a diagnosis of gastric dyspepsia of indeterminate causation. The attacks were not very severe and were never referred to the region of the kidney.

On Saturday evening, the day before admission to the hospital, while about to descend the stairs of an elevated railroad station in Brooklyn, he caught his heel in the rubber matting and pitched headlong down a flight of stairs. He was rendered unconscious by the fall, was picked up by a patrol wagon and taken to the police station. He regained consciousness a few moments after he was hurt, and felt well enough in a short time to proceed to his home in the city of New York. He received several contusions of the face and scalp, but no other injuries of which he was conscious except that he suffered a moderate amount of pain in the left loin. He went to bed and slept fairly well. The next morning he observed that his urine was bloody, and at about the hour of three in the afternoon he came to the hospital in a cab. Dr. Johnson saw him about an hour later.

The patient was a fairly well-nourished individual, rather slender than stout. He said that for some time he had had a chronic cough. There were no external evidences of injury except the contusions of the face and scalp, and a small abrasion in the midaxillary line opposite to the seventh rib upon the left side. Urine passed after he entered the hospital was of a deep port-wine color. The heart and lungs appeared to be normal. His temperature was not elevated; his pulse was 90. He complained of a sense of distention and soreness in the left side of the abdomen and loin, just below the ribs.

Physical examination showed that the left loin was occupied by a considerable tumor mass extending downward to the level of the umbilicus, and within two inches of the median line in front. The mass extended upward beneath the ribs. It was flat on percussion, and the colon, displaced somewhat toward the inner side, lay in front of it and produced an area of tympanitic resonance. The left side of the abdomen over the tumor was markedly rigid and quite tender. The patient looked rather pale and anæmic and a diagnosis was made of a rupture of the left kidney, with a large perirenal retroperitoneal hæmatoma.

The patient's condition being good, Dr. Johnson did not operate until the following morning. Under gas and ether an incision was made parallel to the ribs upon the left side, beginning at the outer border of the rectus in front, two inches below the costal margin and extending backward and outward slightly convex downward to the outer border of the erector spinæ muscle. Upon opening the loose perirenal fat, a hæmatoma of moderate size was entered; but further explorations showed the presence of a large polycystic kidney, which was ruptured horizontally at the junction of the upper with the middle thirds of the tumor.

Upon palpation of the opposite kidney through the wound, it appeared to be of normal size and consistence. The kidney upon the left was removed without difficulty and with trifling hemorrhage. The ureter appeared normal, and the renal artery and vein were of about normal size. The wound was sutured, with a suitable gauze drain left at its posterior angle. The patient did not suffer from shock, and continued to pass abundant urine. The wound healed *per primam*, except for the drainage opening.

Upon the third day after the operation the patient passed 72 ounces of urine, and three weeks after the operation he was passing from 40 to 50 ounces a day. It was of a specific gravity of 1012, and contained a perceptible trace of albumin, together with granular and hyaline casts. The patient had a moderate cough, with very little expectoration, in which no tubercle bacilli had been found. The probabilities seemed to be that he would survive, but whether or not his remaining kidney would continue to functionate, whether he would die eventually of nephritis, or, on the other hand, whether the organ would undergo a similar cystic change, it was at the time impossible to say. The interesting features of the case were that the tumor had never produced any definite symptoms, and that it should only have been discovered after its accidental rupture, the latter accident being, so far as the speaker was aware, unique.

At present, five months after the operation, the patient is in fair health. His urine is of a specific gravity of 1015 and abundant in quantity. A trace of albumin is present. He has resumed his occupation, that of a clerk.

DR. ELLSWORTH ELIOT, JR., said the prognosis of these cases, so far as changes in the remaining kidney was concerned, was rather unfavorable. Two or three years ago a German writer tabulated a series of 75 or 100 cases, which were gathered from different sources, and in these cases, even where the second kidney was normal at the time of the primary operation, the development of a similar condition in that kidney was apparently hastened.

Dr. Johnson said he could recall only one other case of unilateral polycystic kidney, which was observed for about four years. The opposite kidney, which in the meantime had shown fairly well marked signs of nephritis, then became greatly enlarged; the patient became uræmic and died without a second operation having been done.

Dr. Joseph A. Blake said it had been claimed that by draining some of these cysts we could relieve the pressure on the parenchyma. In one case of double polycystic kidney he simply punctured some of the cysts. This procedure gave no immediate bad results, but the patient died in a few weeks of renal insufficiency.

THE TWO-STAGE PRINCIPLE IN OPERATIVE SURGERY.

Dr. Howard Lilienthal read a paper with the above title for which see page 30.

Dr. Charles N. Dowd thought that prostatectomy certainly offered a field for the two-stage operation. Many of the cases which he saw were in very old men who had been allowed to go on until there was complete obstruction. Under those conditions it is certainly a very difficult problem to get them through alive, and their chances are greatly improved by first making an opening into the bladder and completing the prostatectomy at a later date.

Dr. Algernon T. Bristow said that while he was inclined to agree with some of the statements of the author, he would not favor a two-stage operation in dealing with a pus kidney unless the patient was manifestly in an extremely bad condition from sepsis. Personally, he had never done an operation on a pus kidney in two stages, having always been able to complete the operation at one sitting and having regarded it as a source of congratulation that he had entirely disposed of the focus of infection. Up to the present time, he had had no reason to regret his course in dealing with this class of cases. The complete removal of the kidney at a single sitting obviated the necessity of giving an anæsthetic twice, and he thought that a kidney that could be removed at the second operation in five minutes—as Dr. Lilienthal had mentioned in the report of one of his cases—could also have been removed at the primary operation without unduly lengthening the time of the procedure.

In regard to operations on the bladder, where the patient was suffering from long-continued cystitis, there he regarded preliminary drainage as extremely useful, because it diminished the chances of infection.

Dr. Alexander B. Johnson, discussing the treatment of suppurating kidney, said he did not agree entirely with Dr. Lilienthal that such a kidney should be treated, as a rule, by a primary nephrotomy and a secondary nephrectomy at some later period. In a moderate number of cases—not so much those that we ordinarily recognize as pyonephrosis—but cases of infected hydronephrosis with a very large sac, primary drainage of the sac and a subsequent nephrectomy after the sac has had time to diminish in size, was sometimes of advantage; but this did not apply to the ordinary type of acute or chronic suppuration of the kidney. Dr. Johnson said it had been his experience, in dealing with pyogenic infections of the kidney, whether the infection be hæmatogenous or secondary, due to tuberculosis or renal calculus, that such a kidney, after incision, if not already seriously infected with pyogenic germs, would soon become so, and that its removal at a secondary operation was more difficult than it would have been at the time of the primary operation. He could recall a number of instances, however, in which he felt obliged to do first a nephrotomy and later a nephrectomy, but those were cases where the kidney was not only the seat of a primary or secondary pyogenic or mixed infection, but in which there was also a large perirenal abscess. In some of those cases he had felt that the risks of a nephrectomy were too great to be undertaken as a primary operation. He had not followed this procedure as a matter of choice, but because he felt that there was nothing else to do, and the removal of the kidney at a later period had often proven a very difficult operation.

In cases of uronephrosis or hydronephrosis which could not be treated by conservative means, even where the tumor was of large size, he would look upon a primary nephrectomy as preferable to a primary nephrotomy and drainage, because in spite of the utmost care they were apt to become more or less septic before the second operation was done.

Dr. Lilienthal, in closing, said that during the past two and a half years he had done at least sixteen cases of prostatectomy in two stages, and all of those cases had recovered. Many of these patients were of advanced age, and some of them were extremely feeble, with cardiac and other lesions. This method had also been practised with success by Drs. Goldenberg, Cabot and Ware.

Dr. Lilienthal said that Dr. Johnson had evidently misunderstood him in regard to his method of treating pus kidneys. In his paper he had made no reference to hydronephrosis, and he would not treat such a condition of the kidney in two stages without a particular reason. The method he had advocated related to the treatment of pus kidney. First, an incision should be made into the kidney; then, when the patient had recovered from the effects of that incision, in four or five days, certainly less than ten days, before dense adhesions had formed, it would be found that the kidney had shrunk away from its bed, and could be removed in less than one-quarter of the time it would have taken at the primary operation. It was not a secondary nephrectomy that he was urging, but a *two-stage* nephrectomy, which was quite a different thing. There was practically no mortality when the operation was done by this method.

Stated Meeting, October 27, 1909.

The Vice-President, Dr. Ellsworth Eliot, Jr., in the Chair.

EPIDIDYMECTOMY FOR TUBERCULOSIS.

Dr. Frank S. Mathews presented a man 39 years old who gave a history of having had tuberculous glands removed from both sides of his neck by Dr. Murphy of Chicago, 13 years ago. About five years ago he suffered from frequent urination and pain for a few months. These symptoms then disappeared, but a year before operation he developed a swelling on the left side of the scrotum. He consulted a physician, who regarded it as a hydrocele and aspirated it several times. It always recurred, however, and subsequently a similar swelling developed on the opposite side.

When Dr. Mathews first saw the patient, two and a half years ago, both sides of the scrotum were occupied by a tumor about double the size of an adult fist. There were no evidences of tuberculosis elsewhere in the body. The patient's temperature, during the twenty-four hours, ranged from normal to 101. The case was regarded as one of tuberculous epididymitis, and a double epididymectomy was done. Through incisions on the outer sides of the scrotum the epididymis and vas of either side were removed without injuring the spermatic vessels. The operation, which proved somewhat difficult, occupied an hour and a half. There was fluid in both tunica. Both wounds were closed with the exception of an opening for a small piece of rubber tissue. Both testes were hard at the time of the operation, but gradually became normal to the feel. The patient has gained about 20 pounds since the operation, and is now enjoying excellent health. There is nothing abnormal in his urine at present. His sexual power, which was in abeyance at time of operation, has returned to the extent that he has sexual desire and orgasm but no emission. The prostate feels slightly nodular. His wife became pregnant between the times of involvement of the left and right testicle.

SARCOMA OF THE INTESTINES AND STOMACH.

Dr. John F. Erdmann presented a man 57 years old who came under his care in June, 1909, with the history that about one year ago he began belching and vomiting bile, and had attacks of pain encircling his abdomen, particularly marked in the lateral regions. These pains would subside on expelling flatus. Three months before coming under observation he had acute pains in the pit of the stomach, and vomited some food, but the vomitus contained no retention evidences. He had lost considerable weight during the preceding six months. He was constipated. He had never vomited blood. Lately, he had had some food intake pains. He complained of a painful tumor in the lower abdomen, which he said was fixed.

Upon examination, a tumor the size of a cocoanut was found fixed to the abdominal wall between the umbilicus and the pubis.

There was a certain amount of mobility, deep-seated, as though the tumor was pedunculated. Palpation was extremely painful. By rectum, the patient was very sensitive, the examining finger just reaching the mass.

On June 5, 1909, upon exposure, a tumor was found invading the jejunum and ileum, firmly adherent to the parietal peritoneum in the median line. This was released without any difficulty by excising the peritoneal invasion. The tumor was found to consist of large sections of jejunum and ileum. The coils were doubled upon themselves, with a large central coil invaded by the tumor occupying the lumen and walls of the gut. At the proximal end, well up in the jejunum, two other masses were found invading the lumen to such a degree as to produce stenosis. The balance of the intestines, both proximal and distal, were found negative.

Forty-eight inches of jejunum and ileum were excised, and a side-to-side anastomosis made by means of the Roosevelt clamp. Previous to completing the peritoneal toilet, a complete examination of the abdominal contents was made, and upon palpating the stomach a mass about the diameter of a silver dollar was found in its greater curvature. No other metastases presenting, this was excised, the opening sutured and the abdomen closed.

After a rather stormy postoperative convalescence in the first week, the subsequent period was uneventful. Six weeks after the operation the patient weighed 129 pounds. His present weight was 157 pounds, a gain of thirty pounds in three months.

Pathologically, the growth was reported as a small round-celled sarcoma.

OPEN ULCER OF STOMACH CLOSED BY ADHERENT GALL-BLADDER: GASTRO-ENTEROSTOMY.

Dr. William A. Downes presented a man of 42 who gave a history of stomach trouble extending back for many years. In July, 1908, this condition began to be accompanied by pain and periodical vomiting—about twice weekly. The following December the vomiting became almost continuous and the pain more severe. He was unable to retain scarcely any food and his weight fell from 150 to 115 pounds. His condition was such that he was practically bed-ridden.

At the time of the operation, on April 12, 1909, a small tumor could be felt in the epigastric region, just in the median line. Upon opening the abdomen and exposing the pyloric end of the stomach by raising the liver, an ulcer of the stomach about the size of a silver 25-cent piece presented. This was an open ulcer, with its edges firmly agglutinated to the overlying gall-bladder, and this had prevented any escape of the gastric contents. Actual peritoneal adhesions between the gall-bladder and stomach existed only along the posterior margin of the ulcer. There was extensive induration involving the entire pylorus and the mass was firmly fixed posteriorly—in fact the condition was thought most likely to be malignant, but the extent and location made any attempt at removal out of the question.

As the patient was in very poor condition, the opening in the stomach was sealed by replacing the gall-bladder over it, suturing it with catgut, and covering it with omentum. A posterior gastro-enterostomy was then done.

The patient made a rapid recovery, and had had no gastric pain or vomiting since the operation. He had gained about 30 pounds in weight.

In reply to a question as to why he had not closed the opening in the stomach in the usual way, and had used the gall-bladder instead, Dr. Downes said that aside from the patient's poor condition, the depth of the ulcer was such that it was almost impossible to get at it. No attempt was made to remove the mass which involved the pylorus, as it would have occasioned too much shock. The condition at the time was regarded as unquestionably malignant, and it was thought that the quickest and most expedient way to meet the requirements was to take advantage of the position of the gall-bladder.

In view of the subsequent history of the case, and the marked improvement in the man's condition, the mass which was seen at the time and which had since disappeared, was probably composed of inflammatory exudate.

Dr. Ellsworth Eliot, Jr., said the method described by Dr. Downes had been utilized by an English surgeon, who had used the gall-bladder successfully in one or two instances in sealing a gastric perforation. The danger of a possible twist in the gall-bladder in manipulating it for this purpose should not be lost sight of.

Dr. Eliot said that in case of gastro-enterostomy for supposed pyloric cancer upon which he operated about nine years ago, the anastomosis was completed by means of a Murphy button. The operation disclosed a hard circumferential nodular growth in the pylorus that appeared unquestionably to be carcinoma. Three months after the anastomosis, when the abdomen was again opened to radically excise the growth, the tumor had completely disappeared. It was doubtless inflammatory in nature.

For seven or eight years after these operations, the patient complained of intermittent attacks of abdominal pain. At the end of that time the Murphy button was passed per rectum and her attacks of pain were relieved.

INTESTINAL ANASTOMOSIS BY INVAGINATION: UNION OF COLON WITH RECTUM.

Dr. Walton Martin presented a girl who had been operated on by Dr. Chas. L. Gibson for the removal of an intraligamentous cyst, with adhesions. In the course of its removal, the sigmoid was denuded, necessitating the resection of a portion of it. An anastomosis was then done by invaginating the lower end of the colon into the upper end of the rectum, and inserting a row of catgut sutures. A subsequent examination with the sigmoidoscope failed to show any constriction in the lumen of the bowel.

NEPHRECTOMY FOR HYDRONEPHROSIS.

Dr. Alexander B. Johnson present a man 41 years old, a driver by occupation, who was admitted to the New York Hospital on June 26, 1909. The history obtained from him was that a tumor was first noticed in the right hypochondrium seven years ago. It had slowly but steadily increased in size and recently had become painful. The pain was referred to the loin, radiating downward and inward to the groin. The urine was clear, amber in color, acid, with a specific gravity of 1031; it contained calcium oxalate crystals, but neither albumin nor sugar.

The man was operated on by Dr. F. W. Murray on July 3, 1909. Through a right rectus incision, six inches long, a very large hydronephrotic kidney was exposed. On account of its great size, its removal was deemed impracticable, and the sac was thereupon incised anteriorly, giving vent to two quarts or more of a reddish-brown fluid. After the insertion of a drainage tube, the wound was closed. The tube continued to give exit to urinous fluid in large amounts. After a time, ammoniacal infection and decomposition of the urine occurred, and the escaping urine became distinctly purulent. The cavity of the sac was irrigated with various antiseptic solutions in the hope of clearing it, but without much success.

On August 23, 1909, Dr. Johnson excised the sinus and a portion of the former scar, and through an eight-inch incision made below and parallel with the costal border he exposed a large hydronephrotic kidney. It was moderately adherent, and required somewhat prolonged dissection with the hand and fingers before it could be enucleated. The pedicle was clamped and tied *en masse* with ligatures of strong plain gut, and the wound closed by suture. The patient made an uneventful recovery.

In connection with this case, Dr. Johnson showed the specimen, which consisted of a large, hydronephrotic kidney with dilated pelvis and calices. The sac was quite thick and tough, and the kidney structure had, for the most part, disappeared, so far as could be seen with the naked eye. The cyst-like cavity contained numerous spherical and ovoid calculi, 109 in number.

Dr. Johnson, in reply to a question, said the calculi were scattered about in several of the calices, and some were found in the pelvis. He recalled an almost identical case which was operated on by Dr. McBurney. In that case, the kidney had not been previously opened and drained, and the formation of the stones could not be attributed to ammoniacal infection of the urine, as no infection had occurred. In his own case he did not think the entire kidney was infected; probably only some of the dilated calices.

CARCINOMA OF BLADDER AND UTERUS: HYSTERECTOMY, CYSTECTOMY, AND DOUBLE LUMBAR URETEROSTOMY.

Dr. Walton Martin presented a negro woman, 43 years old, who was admitted to St. Luke's Hospital on September 3, 1909. Her chief complaints were bleeding from the uterus, and vesical tenesmus. For the previous fifteen months she had had constant bleeding from the vagina, so that she had been unable to determine the menstrual period. The amount of hemorrhage varied from time to time, but was never very profuse. Three months ago the patient began to have bilateral pain in the lower pelvis, radiating to the back, and vesical tenesmus. There had been no hæmaturia and no increased frequency of urination. She had lost about 25 pounds in weight in the last year.

The previous history obtained from the patient was that she had had eight full-term children and one miscarriage. Menstruation began at fourteen and lasted usually four days. Before the onset of her present illness she had always been in good health. Her family history was negative.

On vaginal examination, the cervix of the uterus was found to be enlarged and hard, and there was an irregular ulcer extending from the cervix to the anterior vaginal wall. Between the cervix and the bladder there was a firm mass apparently involving the bladder wall. Abdominal examination was negative. The woman was poorly nourished and looked ill. Temperature, 100; pulse, 100; respirations, 26. The urine was acid, with a faint trace of albumin. The microscope showed a few red blood cells and leucocytes. The clinical diagnosis was carcinoma of the uterus. On September 6, 1909, under ether anæsthesia, with the patient in the lithotomy position, the ulcerated area on the cervix was cauterized, and an incision made through the anterior vaginal wall, about one-quarter of an inch below the ulcerated surface. An attempt was made to dissect the vaginal wall with the growth away from the bladder, but it was soon seen that the indurated tissue extended into the wall of the bladder in this situation. The vagina was accordingly packed with gauze, and the patient placed in the Trendelenburg position. The abdomen was opened in the midline from one inch above the navel to the symphysis pubis. The body of the uterus, the tubes and the ovaries appeared normal. The cervical portion was enlarged and indurated, and this induration extended into the base of the bladder and the tissue about the right ureter. No enlarged lymph-glands were observed.

The ovarian arteries and the round ligaments were ligated and divided on each side. The uterine arteries were ligated close to their origin. The ureters were exposed for about four inches, then divided three inches above their insertion in the bladder, and through one-inch stab-wounds in the lumbar region they were drawn out by artery forceps. About one inch of the ureter was allowed to hang free from the skin of the loin, and a small catheter was inserted into each ureter. The bladder and uterus were dissected out, the vagina being divided about one inch below the ulcerated surface of the cervix. There was profuse hemorrhage from the vaginal vessels. The vagina was closed with catgut stitches.

On removal of the bladder and uterus it was evident that too much peritoneum had been taken away to make it possible to cover the denuded surfaces. A gauze drain was introduced in the lower angle of the wound, and the abdomen was closed.

After the operation, the patient was in moderate shock for a few hours. The pulse was 100, regular, but weak. On the following day the pulse was of good force, temperature, 102; respirations, 24. On the third day the temperature was normal, the pulse 100.

On the second day, the drainage from the ureters being unsatisfactory, the catheters were removed, the ureter ends split and turned back and sutured into the lumbar wounds. From this time on the right ureter drained normally, drop by drop. The skin about the orifices of the ureters was kept scrupulously clean, and the urine allowed to escape into sterilized gauze pads. The patient seemed to be comfortable. The left ureter, however, did not drain properly, only a few drops of urine escaping from time to time.

On the eighth day the skin stitches were removed from the abdominal wound, which had healed by primary union except for the drainage tract. This was closed at the end of the second week. On the eighth day a ureteral catheter was passed into the pelvis of the left kidney. The urine escaped drop by drop. On the following day the patient had a chill, and the temperature rose from normal to 104. Two days later the left ureter was washed out with normal salt solution. After that there was no further interference with the ureters. For about ten days there was an afternoon rise of temperature; then it gradually fell to normal. The patient gained strength and flesh, and left the hospital 35 days after admission in good condition. She returned to her home, and now did her usual housework—washing, ironing, and cooking. She wore about her loins a sterilized gauze pad, which she herself changed every four hours.

Histological examinations made from sections taken from the cervix and wall of the bladder showed carcinoma of those organs.

HYDRONEPHROSIS, CONGENITAL, RELIEVED BY NEPHRECTOMY.

Dr. Samuel Alexander presented a man, 22 years old, who was operated on in Christ Hospital, Jersey City, in June, 1908, for the relief of intermittent attacks of pain in the right hypochondrium, associated with enlargement of the kidney on that side. At that time, two incisions were made, one abdominal, apparently for exploratory purposes, and another in the right lumbar region, through which the kidney was opened and drained. The patient made a good recovery from this operation, and went home. Ten days later he had a sudden elevation of temperature. The lumbar wound re-opened, and there was a profuse secondary hemorrhage. A tube was inserted into the kidney, and this tube was worn continuously for eighteen months. The tube was attached to a rubber glove which was worn next to the patient's body, and into this about 16 ounces of urine was excreted daily. The urine was of a very low specific gravity and contained but a trace of urea. The opposite kidney secreted about 30 ounces of normal urine daily through the urethra.

When Dr. Alexander first saw this patient at Bellevue Hospital on February 1, 1909, his condition had become so uncomfortable from the long-continued drainage of the urine through the loin that an operation for his relief was deemed imperative. The right kidney was exposed through a lateral incision, and it was found to be in a condition of apparently congenital hydronephrosis, which was probably the result of its anomalous blood supply, the renal vein and artery overlapping and compressing the ureter, causing at times complete occlusion of the latter. The kidney was made up of three or four large cysts, containing cloudy fluid. An intracapsular enucleation of the organ was done, and the patient made a good recovery.

Dr. Alexander said that the chief reason for showing this case was to bring up for discussion the question of the post-operative treatment of these patients, as well as cases of inoperable tumor of the bladder, where double nephrostomy was imperative. In the case he had shown, the patient was rendered uncomfortable for many months by wearing a drainage tube which made it impossible for him to rest on his back.

By doing a ureterostomy, as in the case shown by Dr. Martin, we certainly increased the comfort of those patients with inoperable cases of tumor of the bladder. In such cases he was in favor of doing the operation in two stages,—first doing a double ureterostomy and subsequently extirpating the bladder. The postoperative treatment of these patients was of the utmost importance to the patient's comfort.

Dr. Clarence A. McWilliams said he had seen the late Dr. McCosh perform three such operations on the uterus and bladder where the ureters were cut and allowed to remain *in situ* in the pelvis. The urine was passed per vagina—the patients wearing rubber urinals. One of these patients was alive a year after the operation, the second died of recurrence within a few months, while the third was lost sight of subsequently.

Dr. Erdmann said he had seen paroxysmal anuria occur after unilateral ureterostomy. In that case it was demonstrated that there was no blocking of the opposite ureter, and the temporary anuria was apparently due to irritation of the ureter.

Dr. Martin, in closing the discussion, said he preferred to do an implantation of the ureters in the loins rather than to let them dangle free in the laparotomy wound; he regarded the former as a cleaner and safer procedure. In reviewing the literature of the subject he had found the report of one case of exstrophy of the bladder where a double ureterostomy had been done with loin implantation by Dr. John T. Bottomley and the patient was alive and fairly comfortable fifteen months after the operation. In another case done for carcinoma of the bladder, reported by Rovsing, the patient wore a rubber apparatus which kept her dry and comfortable, and she was in good condition one year after the operation. In his own case, Dr. Martin said, the patient kept herself fairly comfortable by the use of layers of gauze. He regarded the two-stage operation of distinct advantage in dealing with inoperable tumors of the bladder. In reply to a question, he said that he had feared that the ureter would become kinked in the course of his implantation, but the introduction of a catheter had shown that none had occurred.

AN OPERATION FOR PARALYTIC SHOULDER JOINT DUE TO INFANTILE PARALYSIS.

A paper with the above title by Dr. O. Kiliani, was presented and, in the absence of the author, was read by the secretary, for which see page 79.

TRANSACTIONS
OF THE
PHILADELPHIA ACADEMY OF SURGERY.

Meeting, held October 4, 1909.

Dr. William J. Taylor, President, in the Chair.

STRANGULATED INGUINAL HERNIA IN A TWO-WEEKS' OLD INFANT.

Dr. John H. Jopson reported the case of a two-weeks' old infant seen by him June 24, 1909, with a history indicating that a hernia had been down about 24 hours. Under taxis, reduction seemed to be effected, and a wool truss was applied. On the following morning the infant was brought to the Presbyterian Hospital with the hernia again protruding and fecal vomiting. Under chloroform, herniotomy was done. The edges of the sac were sutured with the edges of the canal and the external ring, a typical Bassini operation not being possible. Uncomplicated recovery. Dr. Jopson remarked that the strangulation of a hernia while not a very common accident in children, was proportionately more common in early infancy than in older children. It has been his experience that an operation is less frequently required to reduce a strangulation in infancy than is the case with adults. Hence taxis should always be given a trial in cases seen early, unless there is some distinct contra-indication. With regard to the frequency with which operation is required, it would seem that there has been a tendency to underestimate rather than to overestimate the number of cases that have called for operations. Coley quotes the statistics of Estor in this connection. Estor was able to collect 225 cases of strangulated hernia in children under two years of age, but found that in nine of the largest of the largest clinics of Europe the records showed not a single case. At the Hospital for Ruptured and Crippled only 17 had been operated upon in children, and of these 12 were under two years of age. Telford, as quoted by Ashhurst, collected 224 cases under four years that had been operated, and of these 112 were infants under six months, and 13 were given by Ashhurst as one month old. Fifteen cases were added by Ashhurst, the youngest 14 days, and the oldest 14 months. Dowd analyzed 125 cases under one year. It will thus be seen that the number of cases available for study is quite respectable. Mortality has been quite low. While Estor's tables show a mortality of 23 per cent., much the same as in adults, both Coley and Dowd agree that this should be lower, the latter stating that it should not exceed 10 per cent. when the operation is done promptly. The case here reported is seen to be among the youngest, although operation has been done for strangulated umbilical hernia as early as the second day. Dr. Jopson had seen two other cases in very young children, one aged one month being under Dr. Wharton's care, and the other, aged two months, was seen with Dr. Hodge. The latter case was a case of strangulation of the ovary, which puts it in a class by itself, as the gut was not involved. All of these cases recovered.

Dr. Astley P. C. Ashhurst said that during the last year he had seen three children, one of six weeks, one of eleven months, and one of three years, in which he had diagnosed strangulated hernia and on whom he had operated with recovery. A fourth child, but four months of age, was then seen, with a history of the sudden appearance of a lump in the right groin, pain, vomiting, obstipation, and fever. Taxis had been tried but the lump could not be reduced. He thought this also to be a strangulated hernia, but on operation found a hydrocele of the cord!

Dr. J. B. Carnett said that the youngest patient he could recall ever having seen with incarcerated or strangulated hernia was a child about four years of age. For several days before admission to the University Hospital the child had abdominal pain, rigidity, fever, frequent passage of stools composed of mucus and associated with severe rectal tenesmus. On examination just prior to operation the child exhibited symptoms of extensive peritonitis. Tenderness was noted over the entire abdomen but was most pronounced over a right inguinal hernia which did not give any impulse on crying and which very gentle taxis failed to reduce. Under ether the hernia slipped back spontaneously. On opening the abdomen through a median incision there was found a wide-spread peritonitis due to a perforated appendix which was adherent by its tip to the rectum.

The hernia in this patient was not seriously considered as the primary cause of the patient's trouble. The child had been seen outside of the hospital by several competent physicians who could not have failed to observe the very obvious hernia had it been present from the onset of the illness. It therefore seems probable that the hernia in this patient was forced out sufficiently to become incarcerated by the abdominal straining incident to severe rectal tenesmus.

The case belongs to a type of hernia which may easily lead to an error in treatment, viz., that class of cases in which a very evident strangulated or incarcerated hernia might account for all the symptoms presented at the time of examination but in which careful questioning will elicit the fact that the hernia developed secondary to some other cause for abdominal straining. Operative treatment may be necessary for relief of the hernia but is often more urgently imperative for the primary abdominal condition, the symptoms of which have been masked by the strangulated or incarcerated hernia. In the absence of an exact history the underlying primary condition may readily be overlooked and may be the cause of a lethal termination despite a skilfully performed operation for hernia.

ILEUS DUE TO GALL-STONE.

Dr. Charles F. Mitchell exhibited a gall-stone removed at the Pennsylvania Hospital, in the service of Dr. Hutchinson, from a woman, aged 61, who gave a history of having been sick ten days, the only symptoms being vomiting. On admission she had a normal temperature; pulse 120, very weak and compressible. The vomitus was fecal in character. This had been going on for some hours. She had no abdominal distention or tenderness, and no rigidity, the only symptom being the fecal vomiting. She said she had a distressed feeling in the abdomen. The abdomen was opened by an incision in the upper right rectus; the peritoneum was found perfectly normal; she had very fat abdominal walls, about four inches in thickness and took ether very badly. The hand introduced into the abdominal cavity immediately came down on a mass in the small bowel high up either in the upper part of the ileum or in the jejunum, and this mass proved to be a gall-stone. A small incision was made in the bowel wall, over the stone, through which the stone was removed, but the patient died a few hours later.

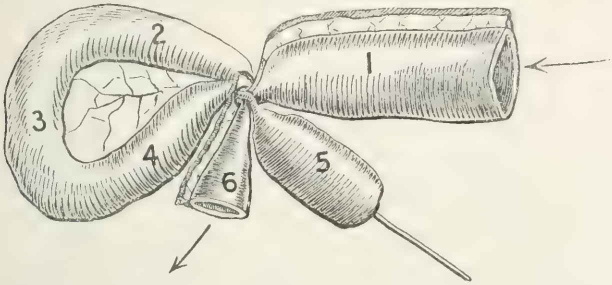
Dr. John H. Gibbon said that last spring he operated upon a case presenting symptoms quite similar to those of Dr. Mitchell's case. The patient was an old lady 68 years of age, in whose case, three months previously, he had diagnosed gall-stones and advised operation. She was taken rather suddenly ill with severe abdominal pain, persistent vomiting, and marked exhaustion. Dr. Stengel saw her on the day of operation with her physician, Dr. Mary Griscom, and thought that in addition to the gall-stone condition she probably had an acute pancreatitis. When seen by Dr. Gibbon she was very much exhausted, but her circulation was good and there was a very little rigidity and tenderness in the upper right quadrant; the rest of the abdomen was soft. The tenderness was not as marked in the gall-bladder region as it had been during the three months previous. On opening the abdomen through the upper right rectus the gall-bladder was found densely adherent to the duodenum. On separating the structures a large hole was found in the duodenum and a corresponding one in the gall-bladder. There was considerable induration around the openings; and on closing it was found that the duodenum was practically obstructed, so that a gastro-enterostomy was done. The patient continued to vomit considerably during the next twenty-four hours but gradually improved in spite of an infection of the wound. On the sixth day she passed two gall-stones, one of enormous size, quite as large as the one shown by Dr. Mitchell. The patient made a good recovery and is well to-day.

Persistent vomiting, with a flat and soft abdomen, is indicative of some obstruction high up in the intestinal tract.

INTRAPERITONEAL HERNIA OF ILEUM THROUGH RENT IN MESENTERY.—ADHERENT MECKEL'S DIVERTICULUM.

Dr. A. P. C. Ashhurst reported the history of a boy of 12 years who had never been sick, who fell and hurt his hip. On the following day he ate two large bunches of grapes, a quantity of chocolate cake, and soon afterward developed pains in his stomach, then vomited. For three days symptoms of obstruction of the bowels continued unrelieved by medical treatment. He was then admitted to the Episcopal Hospital in the service of Dr. Frazier, to whom Dr. Ashhurst was indebted for the privilege of operating. On admission the patient had a temperature of 103°, the abdomen was distended, he was vomiting fæces and passing blood and mucus from the bowel. When this child was examined, the umbilicus did not look normal,—it seemed large and thin, suggesting the possibility of the presence of a Meckel's diverticulum. An incision was made in the middle line below the umbilicus. On opening the abdomen the omentum was adherent. On freeing the omentum there was a gush of fecal smelling bloody fluid, after the escape of which a black coil of gut was seen lying in the pelvis. This was pulled up, and seemed like a volvulus; on turning it up there appeared on the under side a Meckel's diverticulum about as thick as two fingers, not quite as long. Something snapped, and the diverticulum with a long cord attached to its tip came out of the wound. The gut was then carefully packed off and examined. There seemed to be some constriction preventing reduction of the volvulus, and as the entire loop was gangrenous and the constriction could not be relieved, it was decided to take the whole thing out. When the clamps were applied for resection the gangrenous bowel burst, but the discharge occurred only on the gauze packs. The affected portion of intestine, from 14 to 18 inches, was resected, and an end-to-end anastomosis was done; the pelvis was drained by a glass tube, and the operation hastily completed (time 40 minutes)

FIG. 1.



Volvulus of loop of ileum strangulated in opening in mesentery, complicated by Meckel's diverticulum. The arrows show the normal fecal current. The loop of ileum (2, 3, 4) has passed through an opening in mesentery until arrested by drag on Meckel's diverticulum (5), which springs from ileum at junction of 4 with 6, and which is attached, through fibrous cord running from its tip, to anterior abdominal wall in left hypogastric region.

as the child was in very bad shape. Death occurred three hours later.

It took a long time to determine what the specimen was. Finally the conclusion was reached, after careful study, that there had been a hole in the mesentery and through that the ileum had gone from the upper surface of the mesentery downward as far as it could until it was caught by the base of Meckel's diverticulum. As the diverticulum was attached to the abdominal wall it could not get through; the loop which had passed through the rent then became twisted on itself and gangrene followed.

SUBCUTANEOUS CERVICAL HÆMANGEIOMA.

Dr. John B. Carnett read a paper with the above title, for which see page 65.

OVARIAN CYST WITH TWISTED PEDICLE.

Dr. George G. Ross reported the history of a woman aged 35 years who for eight years had been aware of the presence of a palpable tumor—an ovarian cyst, for which she had refused operation. Three days before admission to hospital she had been treated by an electrotherapeutist; following this treatment she was attacked with violent abdominal pains, nausea and vomiting, for which condition she was brought to the hospital. Upon opening the abdomen a large quantity of free chocolate colored material escaped, and a cyst, the size of a man's head, springing from the right ovary, was exposed. The cyst was gangrenous, twisted about its pedicle, and a rupture in its wall of about 2½ inches in diameter was revealed. The cyst was densely adherent to adjacent structures. Its removal was successfully accomplished, but patient developed general peritonitis with double bronchial pneumonia, resulting in death after 36 hours.

OVARIAN CYST WITH TWISTED PEDICLE; CHRONIC APPENDICITIS.

Dr. Ross reported the case of a girl aged 12 years, who was brought to the hospital on the sixth day after the onset of pain in the right iliac region, she had also a palpable mass in the left lower abdomen, extending to the median line. Upon opening the abdomen the mass on the left side proved to be a cyst of the right ovary, twisted on its pedicle two and one-half turns. It was very dark in color and evidently was approaching gangrene.

It was extensively adherent to the surrounding structures. Adhesions were separated and the tumor removed. The appendix was found in a state of chronic inflammation and was likewise removed. The reporter was of the opinion that a twist of a pedicle of an ovarian cyst had been occasioned by the active peristalsis of the bowel produced by an acute exacerbation of chronic appendicitis.

OVARIAN CYST COMPLICATED BY UTERINE MYOMA UNDERGOING MALIGNANT CHANGE.

Dr. Ross reported the history of a woman, 45 years of age, who for five years had been aware of the presence of a tumor within her abdomen. Recently the tumor had increased rapidly in size. Upon admission her appearance was very striking, with drawn face, emaciated arms and chest and greatly swollen abdomen; circumference in largest part 54 inches. The weight of patient with tumor was 217 pounds. An abdominal incision exposed a multilocular cyst which was removed, bringing to view multiple myomatous tumors of the uterus, the largest one the size of a man's head, which were removed by partial hysterectomy. The operative shock was controlled by saline infusion. Subsequent uneventful recovery. After the removal of the tumors the patient weighed 115 pounds, making 102 pounds as the approximate weight of the tumors. Among the myomatous masses removed was a small nodule of tissue of a cellular constitution with comparative little intercellular substance and no well defined connective tissue aside from a small amount around a few of the larger blood-vessels; the cells making up the growth were ovoid and spindle shaped, to some extent arranged in fasciculi, particularly the spindle-shaped cells, while the ovoid cells were without such definite arrangements. These cells stained well, showing good nuclei and nucleoli; a few mytotic figures were seen.

Dr. William J. Taylor stated that many years ago he was present when Dr. Keen removed from the abdomen of a girl of 15 a tumor which weighed 118 pounds. The girl weighed 90 pounds after the tumor had been removed. The appearance of the abdominal cavity after the tumor had been removed was most extraordinary, suggesting a disembowelled subject. The girl made a good recovery.

CORRESPONDENCE.

EXAMINATIONS OF HOSPITAL INTERNES.

Editor Annals of Surgery:

The frequency of complaints concerning the general efficiency of the internes in large hospitals is a matter of common knowledge. These complaints, leaving aside all criticisms of a personal nature, concern less the actual amount of information possessed by internes than their readiness to apply such knowledge. In matters of intricate diagnosis and in the domain of the special branches of medicine, familiarity with basic facts and the technical skill necessary to apply them are both essential.

In comparing the examinations now held for the selection of internes with the examinations held some years ago when the complaints now prevailing were rarely if ever heard, one striking difference is to be noted. The examinations as at present conducted cover only the major divisions of medical practice and include few questions—and these of broad and common type; they are distinctly restricted in their scope; and they are generally directed to subjects of such prominence that ignorance of them would be regarded as more or less shameful. Apparently what has happened all over the country is this: Because of the superficial character of the examinations an undesirable group of men have been able to show an excellence which is merely apparent, and higher grade men have generally absented themselves from competition by reason of the fact that they have won posts in the few institutions, regarded as "exclusive," either for the proper reason that their competitive examinations are stricter, or for the improper reason that the positions are secured through personal or family influence.

There can be little doubt, of course, that back of it all the fault may be assigned to the schools from which these internes are graduated. Granted that there are differences in the educational work of schools, it must be clear that as far as formal text-book knowledge of symptomatology, diagnosis and therapeutics of the more common diseases is concerned, these points, as the higher lights in the general picture, are probably taught with equal insistence in the poorly qualified school and in the better institution. The real differences would be much better brought out either by extending the scope of the examination questions so as to include the special branches of practice and more of the fundamental and technical subjects, or by insisting also upon actual bedside and laboratory practical examinations. The generally accepted high grade of the personnel of our national medical service is doubtless due to the fact that the examinations leading to them embrace all these points, and bring out the candidate's general educational qualifications.

It may be thought that the labor connected with such thorough examination of a large number of candidates would be out of proportion to the value of the results in choice of hospital internes; but without effort little can be attained in any direction. The matter—involving directly human life—is unquestionably of sufficient importance to warrant any effort necessary to better existing conditions. The drift of the best men in college classes to hospitals with high demands, even though these be sometimes institutions with restricted chance for experience, is undeniable. When hospital selection is purely a personal matter, a question of "pull," of possession of individual or family influence, the institution of course deserves just what it may get.

If, in actual truth, the burden of thorough examination be a matter of serious difficulty the institutions concerned should arrange to take advantage of the results of the State Examining Boards. On its face this may seem impracticable, but in reality the objections are purely apparent and might easily be obviated by adjustments which would vary with different institutions and in different states. It is always easy to obtain from colleges the class records of individual students applying for posts of hospital interneship, and the relative standing of schools might be well determined from year to year by the records which the *Journal of the American Medical Association* publishes annually (for last report see *Journ. Am. Med. Assoc.*, May 22, 1909) indicating the proportions of failure of candidates for license from the different schools of the country. Either such data might form the basis of selection alone; or there might be added a brief personal examination of the candidates, preferably of a practical (bedside and laboratory) character.

Careful consideration should, however, be given to the matter of school standing if such a plan be considered.

Many small schools with poor clinical and laboratory facilities are nevertheless able by a high development of the " quiz " system of instruction to prepare their graduates in an exceptional manner for formal non-practical examinations; yet in actual work these men fall far short of the graduates of schools in which the method of teaching takes little or no note of possible examinations, and they are usually not desirable from the hospital standpoint. Further, in comparing the percentage records of schools of known worth, due consideration must be given to the number of men examined and to the number of boards before which they have been known to appear. Schools with more than 100 candidates by the law of chance, are sure to suffer more than equally competent schools offering but 10 candidates for gradation by a board of examiners. Boards of examiners vary much among themselves; and the chance of a given number of candidates meeting stringent examiners and suffering commensurately in grades must increase with the number of boards at whose hands the class is examined. Further, inasmuch as the methods of home boards are more likely to be studied by candidates, as much or even more weight should be given to the records of each school before boards other than those of the home state.

Concrete examples may be offered in this wise. A number of medical schools in the tabulated records published in the *Journal of the American Medical Association* have perfectly clean records in the examinations of 1908, for the class graduating in 1908, for graduates between 1903 and 1908, and for graduates of all years appearing; yet in all of these the numbers of graduates examined have been small. The largest was the University of Indiana, with a total number of graduates (none of them antedated 1903) of 76, none of whom failed before any of the three boards before whom they appeared. Yet it is doubtful whether this record should be regarded as highly (and the writer believes to the contrary) as that of the Johns Hopkins University, with 73 candidates and a failure percentage of 2.7, when it is noted that the Hopkins men appeared before 22 state boards and that of 72 of the latter school (men from 1903 to 1908) but 18 appeared before the Maryland Board and the rest before the boards of 21 other states, while of the

Indiana men (none prior to 1903 being given) for the same years 74 appeared before the Indiana Board, and but two in other states.

Similar arguments might well be made in a comparison between Cornell and Harvard. Cornell it is true has a clean record, as has Indiana; but her 69 graduates appeared before but eight state boards in all years, and her graduates of 1908 before but two boards (51 of the total before the home board); while Harvard's 98 graduates appeared before 19 state boards, nearly half outside of Massachusetts, losing 8.2 per cent. by failure.

Undoubtedly of the largest and best known institutions of the country, the University of Pennsylvania presents in this report the most commendable record; and when one recalls how many of the smaller and less fortunately situated and equipped schools maintain by a method of "quiz" preparations their high ratings, and, further, under what particular disadvantages the large classes of such a school as Pennsylvania labor from the laws of chance and from the probability of encountering special difficulties in the distribution of candidates among large numbers of boards, it can scarcely be doubted that Pennsylvania might, with much reason, if so disposed, claim the position of honor for effective teaching and for general efficiency of her graduates. Of 196 graduates of all years, appearing before 27 state boards there was but 1 per cent. failure; of 176 graduates of 1903 to 1908 before 23 state boards there was but 0.6 per cent. failure; and of the 130 graduates of 1908 before 14 state boards none failed. In the 1903–'08 group, 104 appeared before the home state board with no failures; of the 72 appearing before the 22 other than home state boards, the single failure recorded took place.

It would perhaps be unwise to carry forward such comparisons, unless some such scheme as above outlined come to appeal to interested individuals in authority. But the tabulations cited are open for inspection and study at the hands of all; and their interpretation is not difficult if one keeps clearly in mind the special points to be included or evaded as the case may be.

Whatever the method, in the long run the hospital with careful and searching methods of examination will fare best, and the institution with hasty, slipshod and superficial examinations of candidates will suffer most as regards the relative efficiency of the resident physicians, to whom is intrusted in so great a degree the care of the sick and wounded collected within its walls. It is probably true that the interests of a hospital would in the long run be best subserved by selecting a school known to be possessed of high facilities for undergraduate teaching in all lines, making a close affiliation with that school for a period of years, and relying upon the recommendations of the school officials for the choice of internes. The resulting benefit would be twofold—a marked stimulus to educational effort on the part of the school, since the loss of such hospital affiliation after it had once been established would reflect upon the teaching methods; and the impulse toward improving the average type of hospital resident throughout the country.

It is not unjust to either the medical schools—some of which are equal to any to be found in the world—or to hospital residents generally—many of whom are already everything that could be expected, and some of whom are as good as could be desired—to say that taken comprehensively, both schools and residents are susceptible of improvement, and many need it urgently and imperatively.

ROLAND G. CURTIN.

TECHNIC FOR A TEMPORARY ENTEROSTOMY.

EDITOR ANNALS OF SURGERY:

An enterostomy is always dreaded by the surgeon as well as by the patient because of the difficulty experienced in controlling the fecal discharge,—so that any change in technic that tends to improvement will not be unwelcome. One of the principal disadvantages of the artificial anus, especially in the small intestine, has been the difficulty experienced in regulating the escape of the contents of the bowel that keep the dressings of the unfortunate patient saturated almost constantly with liquid fæces. If the opening is allowed to remain for any length of time excoriations that are very painful often result. Attempts to control the fecal discharge have been confined principally to the descending and pelvic colon and these efforts have been partially successful. However, when the fecal current has been more or less successfully controlled there is frequently a marked prolapse of the mucosa. To avoid this difficulty the opening has been made higher up in the colon; but the annoyance is obviated at the expense of fecal control.

I have recently performed an enterostomy of the ileum a few inches above the cæcum for a rectovesical fistula due to an intestinal amœbiasis, and I have had the happy experience during the two months that the artificial anus has been functionating, to see the skin of the patient's abdomen remain *absolutely* free from the slightest trace of moisture. This result, as far as I have been able to learn, has not been attained with the methods in general use.

In connection with this operation, a point of interest in the treatment of amœbiasis by making the enterostomy in the ileum, is worthy of mention. Dr. J. D. Long of the U. S. Marine Hospital Service, who has been associated with me in this case, suggested that the opening be placed in the ileum because of the great advantage that an enterostomy in this region possesses over the appendicostomy on account of the ease with which this part of the intestine can be irrigated; such irrigation is otherwise not possible.

In the technic about to be described, artificial anus of the small intestine is shorn of most of its horrors, at the same time a more complete cure of conditions calling for its employment, especially amœbiasis, may become possible.

Technic of the Operation.—A *large* loop of the intestine, preferably ileum, is drawn out and a spur is made according to any of the accepted methods; the skin is sutured in the ordinary way, and the loop is permitted to remain undisturbed until it is to be opened. Before the intestinal lumen is entered a small slit is made on one side of the centre of a large sheet of rubber dam such as is employed by dentists; this opening is stretched with the fingers, and while tense it is slipped over the loop of the intestine to its base. The rubber encircles the gut closely, just as it does when the dentist applies it over the tooth preliminary to a filling. The hole must be so large that the gut will not be strangled when the rubber contracts. The lower part of the rubber sheet that covers the side of the patient's body is directed into a bucket in which a small quantity of formalin has been placed; in the trough that is formed by the rubber sheet the fecal discharge passes into the container, so that the skin surrounding the artificial anus remains free from moisture.

As I have stated above, the skin of the patient referred to has never been moist, and he has not suffered the inconvenience and disgust that is usually associated with this kind of operation. Whenever soiling occurs from fæces, the rubber sheet and the exposed gut are easily cleansed by flushing with water poured from a pitcher. The important part of the technic is that the intestine is not to be cut flush with the skin, as is usually done, but it is allowed to remain indefinitely. The loop of the intestine exposed has remained normal in appearance and presents no evidence of sloughing.

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ORIGINAL MEMOIRS.

THE RESULTS OF "SPECIFIC" REMEDIES IN DISEASED STATES ACCOMPANIED BY HYPERTROPHY OF THE THYROID.*

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EXPERIMENTAL EVIDENCE AS TO THE PHYSIOLOGY OF THE THYROID, AND A THEORY FOR ITS FUNCTION.

THE adrenal glands contain in their medullary portion the largest collection in the body of what are designated as chromaffin cells. These are the source of adrenalin, or the only known active constituent of these organs. The rest of the chromaffin cells occur in scattered areas and in greater or less amounts throughout the distribution of the sympathetic nervous system and its ganglia. These secreting cells develop from the same original sources as the sympathetic nerves and, in fact, appear to be a part of them. The individual cells present the morphology and microchemical reactions of secreting epithelium, and yet the aggregations of chromaffin cells show some differences from the usual structure of secreting glands. The largest collections of this peculiar tissue outside of the medullary portions of the adrenals exist in the carotid "gland," in some of the larger sympathetic ganglia, chiefly in the abdomen and in the Luschka's coccygeal "gland." It is not sufficient, therefore, to refer to the adrenals alone when considering their internal secretion, as there are many more cells than are found in them for the production of their secretion. Hence the term "chromaffin system" must be employed to accurately describe the medullary secreting or chromaffin cells of the adrenal glands, together with the cells having an apparently similar function and situated in more or less abundance in many other parts of the body,—and this term includes with the chromaffin cells all of the sympathetic nervous system. These chromaffin cells have the peculiarity, therefore, of being an integral part of the sympathetic nervous system and by their secretion of stimulating the terminal filaments of these nerves alone. In other words, it appears to be an example of an organ which in one sense may activate itself in that the product of the chromaffin cells, or adrenalin, activates the terminal sympathetic nerve filaments; and the chromaffin cells and the sympathetic nerve cells are in point of development one.[1] If this principle is correct for one organ or system it may be for another, and therefore the possibility of autoactivation is important in constructing a theory for the physiology of the thyroid, as will be noted later. The cortical portions of the adrenals exist in all animals, but do not belong to the chromaffin system, and nothing definite is known of the function of this tissue except that it does not seem to be of vital importance. The chromaffin system is innervated only by the sympathetic while the thyroid and the pancreas have an additional nerve supply from the vagus, or one of the "autonomous" nerves, according to Pawlow, Langley, and Elliot. In the pancreas, stimulation of the sympathetic nerve supply is said to produce an increased flow into the intestine of a watery fluid which contains little or none of the digestive ferments, and so corresponds to similar experiments with the parotid secretion.

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* Read before the New York Surgical Society, November 24, 1909. See also paper in the ANNALS OF SURGERY, December, 1909, entitled "Significance of Thyroidism and its Relation to Goitre," to which the present paper is supplementary.

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[1] Kohn, in Merkel and Bonnett Ergebwisse, Bd .xii, 1902, p. 253.

The well known experiments of Starling with an extract from the duodenum ("secretin") which he has proved capable of stimulating the functional activity of the pancreas by a "hormone" or chemical substance affecting the gland through the circulation, adds to the complexity of the problem, and suggests, if it does not prove, the close relationship of one organ with another. The apparent importance of the functional activity of the pancreas in the mechanism of thyroidism must be frequently referred to, and this activity as reviewed above is regulated by both chemical and nervous influences.

Comparatively little is known of the secretory activity of the thyroid except that it has an autonomous and sympathetic nerve supply, as stated before, and hence it is presumable that its output varies in amount at least, if not in quality; and this seems regulated automatically according to need.

An elaborate series of experiments by Eppinger, Falta, and Rudinger [2] supplies the best evidence yet obtained of the relationship which seems very close in cases of Graves' disease, between the thyroid, pancreas, and chromaffin system. A summary of their conclusions goes to prove that the thyroid and chromaffin system interact upon each other; that both the thyroid and the chromaffin system exert an inhibitory effect upon the pancreas, which these authors describe as "intense"; that the pancreas, on the other hand, exerts an "intense" inhibitory influence upon the activity of the thyroid and the same effect upon the chromaffin system. To make clear the results of their experiments showing this remarkable relationship they present a diagram in the shape of a triangle (Fig. 1).

However, much the conclusions set forth in this article may be doubted, it seems to be pretty well established that the chromaffin system through its adrenalin product is capable of inhibiting the functional activity of the pancreas, as evidenced by the adrenalin-pancreas diabetes in Herter's well-known experiment. This is important in the construction of an hypothesis for the pathological physiology of the over-active thyroid.

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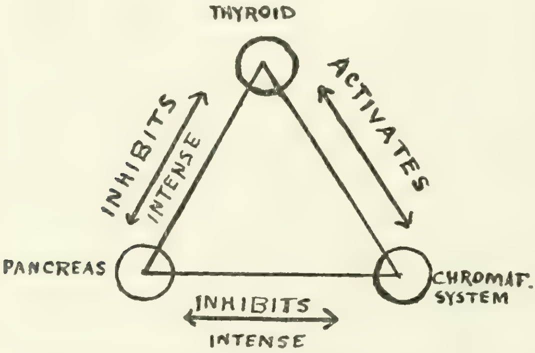
[2] Zeitschr. f. klin. Med., 1908, v 63, p. 1.

It is suggested in the above experiments that the culmination of the interaction of these three organs may take place in the liver,—and there is much to support this view, but as yet it has not been proved.

AN HYPOTHESIS FOR GRAVES' DISEASE.

A theory for the normal physiology of the thyroid and for its pathological condition in Graves' disease must not violate the facts which seem to be established in the above experiments and must conform to and reasonably explain all the clinical observations narrated in the case histories. The fact that there seem to be two active principles which can be isolated from the thyroid, two from the adrenal and one from the pancreas, in addition to the fully formed pancreatic enzymes, necessarily complicates any hypothesis; but all of these must be taken into consideration. The most important in the construction of this theory are the thyroid nucleoproteid and the thyroid globulin. As stated previously, the thyroid nucleoproteid seems to be limited in its effect to increasing the rapidity of the heart action, and it is assumed to do this through

FIG. 1.

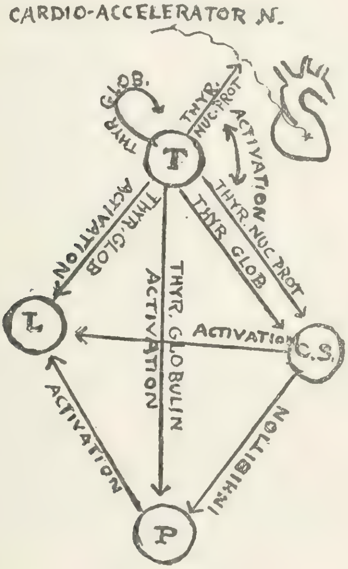


a direct stimulant effect upon the cardio-accelerator or a sympathetic nerve. The chromaffin system is intimately connected with this if it is not a part of it, and no great stretch of imagination is required to believe that the nucleoproteid element in the thyroid secretion, which apparently increases in direct proportion to the severity of the symptoms of thyroidism, also has a direct stimulant effect upon the whole sympathetic or chromaffin system. Thus the thyroid may through the nucleoproteid portion of its product acting upon the chromaffin system inhibit the functional activity of the pancreas. Clinically, the thyroid nucleoproteid seems to remain constant in its physiological effects throughout all the stages of Graves' disease. As the gland becomes degenerated or sclerotic it is conceivable, however, that its total quantity may decrease in amount. The thyroid globulin or second active constituent of the gland, on the other hand, appears to have an effect which is not limited to any one organ or system like the nucleoproteid; it does not increase the rapidity of the heart action except in excessive dosage, and then the tachycardia or nervousness can reasonably be ascribed to the seemingly inseparable small amount of nucleoproteid material with which the thyroglobulin is contaminated in its preparation. Furthermore, in contrasting these two substances there is some evidence for believing that the thyroid globulin, though it may be excessive in amount, slowly or rapidly deteriorates in its physiological qualities as exophthalmic goitre advances through its different stages. This is suggested not only by the variation in symptoms and the clinical advantage of administering a concentrated normal thyroid globulin in certain cases, but by the characteristic changes which take place in the thyroid gland of Graves' disease and of the goitres which give the signs of thyroidism. The histological structure and the content of iodine per gram of gland have already been referred to.

In the absence of proof and for the purpose of the hypothesis it must be assumed that the thyroid globulin has a universally activating effect which is concerned with some fundamental or common chemical process in all the organs and tissues of the body. This violates no known facts, and is suggested by clinical observations in a great variety of pathological conditions. If it activates all organs and tissues the thyroid gland itself should not be an exception, and therefore it is supposed that the thyroid epithelium is to a certain extent activated by part of its own product which returns in the circulation to its source. Hence there are to be considered the thyroid nucleoproteid, which is constant in quality and limited in its effect to the sympathetic nerves or chromaffin system—including, of course, the medullary portion of the adrenals; the thyroid globulin which with the progress of thyroidism deteriorates in quality but yet may increase in abundance as a form of compensation for its deficient quality; and a possible autoactivation of the gland by its own thyroglobulin.

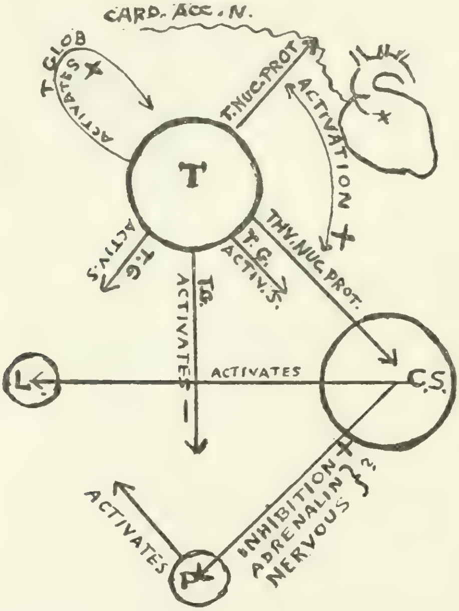
To explain the phenomena of Graves' disease the connection between the thyroid, pancreas, and chromaffin system and their possible effect upon the liver must be brought in. In any condition of over-strain or fatigue it is probable that the output of every secreting organ becomes impaired in quality, and to this general rule the thyroid can form no exception. But its product is assumed to be universally activating,—in other words, necessary for the important chemistry of nutrition in every organ and tissue in the body. Therefore, as a result of fatigue and impoverished nutrition there is a great demand for the thyroid secretion, and it is automatically supplied by the gland through proliferation and increased activity of its epithelium, and the colloid is thus increased in quantity but the quality is poor. There is poured into the circulation as a result of the output a large amount of thyroglobulin, and this carries with it too much nucleoproteid material which over-stimulates the whole sympathetic nervous system including the heart and the adrenals. The chromaffin system through the sympathetic nerves is thus forced to inhibit the functional activity of the pancreas, and the important digestive and nutritional processes which should be carried on in the intestines become impaired or disordered and the general nutrition, already damaged by fatigue, suffers still further. There follows an increased demand for the poor quality of thyroid secretion which is supplied again in too great abundance with stimulation of the sympathetic nerves and inhibition of the pancreas, and thus what may be called the first vicious circle becomes established. The second vicious circle is assumed to lie in the superabundance of poor thyroid globulin, which may be insufficient for some organs and to produce in them an irregular or pathological functionation, yet it returns in the circulation and, in conjunction with the automatic stimuli of a nervous or hormone character, compels the gland to continue its pernicious activity. In the first vicious circle, which is supposed to concern the functional activity of the thyroid, pancreas, and chromaffin system, it seems probable that the alteration in the so-called internal secretion of the pancreas and the hypothetical though highly important effect of this upon the liver, and also the hypothetical direct

FIG. 2.



effect of the abnormal thyroglobulin upon the liver, pancreas, and chromaffin system, are factors of great consequence. The chief disturbance, however, is assumed to be impairment of nutrition dependent upon inhibition of the functional activity of the pancreas by the over-activity of the chromaffin system, which in turn is supposed to be excited by the superabundance of the thyroid nucleoproteid in the abnormal thyroid secretion. The last abnormality, which is also the first in origin, arises as a result of fatigue. This theory does not deny the important possibility that the chromaffin system and not the thyroid may occasionally begin the disturbance. If the chromaffin system is activated by its own secretory product, or adrenalin, as it appears to be, as well as by the thyroid nucleoproteid, then under extreme nervous strain particularly it is conceivable that an over-acting chromaffin system may inhibit the pancreas and this, by damaging nutrition, impair the quality of the thyroid secretion; in other words, bring about an excess of

Fig. 3.



the thyroid nucleoproteid element which then accentuates the difficulty in the already over-acting chromaffin system which in turn is thus stimulated by the thyroid nucleoproteid as well as by its own adrenalin. This reversal, so to speak, of the usual vicious circle, has to be considered in the cases of death from an apparent acute exacerbation of thyroidism following partial thyroidectomy and also in the few cases in the early stages of thyroidism which are manifestly made worse by the antithyroid serum; clinically these cases can be benefited only by the thyroid globulin given subcutaneously or by pancreas feeding.

A diagram to illustrate this theory would then be somewhat as shown in Fig. 2. Under normal conditions the thyroid should be at the superior angle of a diamond-shaped figure at each point of which the other organs are represented of equal size to indicate their equilibrium.

The supposed activating effect of the thyroglobulin is represented by arrows. Arrows represent the hypothetical internal secretions of the pancreas and chromaffin system and their supposed effect upon the liver and each other.

In Fig. 3 is represented the disproportion of these organs produced by an excessive quantity but poor quality of thyroid secretion. The thyroid nucleoproteid is represented by arrows marked *T, N, P.* The thyroglobulin by arrows marked *T, G.* The thyroglobulin appears to have no effect upon the cardio-accelerator nerve proper, and so is not shown leading to this nerve, but the thyroglobulin may have some effect upon the chromaffin system in general, and is shown leading to the system. Its apparent deterioration in quality is represented by shortened arrows. The arrow leading from the chromaffin system to the pancreas is marked as carrying nervous or adrenalin impulses because of the known inhibitory effect of adrenalin upon the pancreas and because stimulation of the sympathetic nerve supply impairs the intestinal digestive quality of the pancreatic secretion (Pawlow).

In extenuation of the temerity manifested in the presentation of this somewhat complicated hypothesis it should be stated that all the evidence as yet obtainable for the pathogenesis of Graves' disease goes to prove it an extremely complicated disorder and in my experience one which has a very high ultimate mortality. That some cases can be cured by appropriate interference has been definitely and repeatedly proved. It has likewise been demonstrated that improper or injudicious treatment either by thyroidectomy or by the administration of iodine or antithyroid serum or thyroid substance may result fatally. Hence in these perplexities one who assumes the responsibility of caring for patients suffering from thyroid disease must formulate some consistent plan on which to found therapeutic efforts, and the hypothesis stated above has served me as a safe and fairly reliable guide in many puzzling situations.

THERAPEUTICS.

A little elaboration of this theory for therapeutic purposes may explain its usefulness. The over-fatigued individual who develops a goitre without other symptoms should not have the goitre excised. It apparently represents a thyroid gland which has hypertrophied to supply a large amount of thyroglobulin to compensate for the demands of the body; and the proper treatment, theoretically at least, should be to feed such an individual the active principles of the thyroid, in their normal proportion; in other words, the combined thyroid proteids. At the same time there is a necessity to correct the bad hygienic conditions which appear to have caused this compensatory hypertrophy. For if the fatigue or nervous and physical strain is continued experience proves the possibility which amounts to probability, that thyroidism will follow. All goitres, as mentioned previously, seem to contain this ever present menace. Over-strain apparently damages the vitality of the thyroid and its ability to properly take up and utilize the necessary iodine; as a result there is an excessive proliferation of epithelium, the nucleoproteid element exceeds its normal proportion and there is poured out an excessive quantity of poor quality of secretion and the establishment of one or both vicious circles. Both have to be considered, one lying in the triangle formed by the thyroid, pancreas, and chromaffin system, and the other in the autoactivation of the thyroid, because some of these simple goitres which exist without causing any constitutional symptoms seem to be changed into the exophthalmic variety by thyroid feeding in injudicious or excessive amounts. The most reasonable explanation of this involves a belief that the vitality of the thyroid has previously been strained to the normal limit, and when this is exceeded by thyroid feeding a species of autoactivation is added to the automatic stimuli and the epithelium proliferates too rapidly and an excess of the nucleoproteid element takes place in the secretion.

A few innocuous simple goitres seem to be changed into the more serious exophthalmic variety by injudicious medication with iodine, and something of the same disturbance as that just mentioned may occur. The goitre must be supposed to have reached the limit of its normal compensation and then an excess of iodine in the circulation supplies more of this element than the existing epithelium can properly assimilate and a more or less rapid proliferation takes place. As a result there occurs an excess of nucleoproteid in the secretion and consequent abnormal activation of the sympathetic or chromaffin system, and the thyroid-pancreas-chromaffin system vicious circle arises.

The possibility of a compensatory hypertrophy which may be the reverse of this has already been mentioned. That is, in the presence of an insufficiency of iodine in the circulation dependent upon an insufficiency of ingested iodine, it is conceivable that the gland may enlarge in an effort to obtain iodine for the manufacture, so to speak, of the necessary amount and quality of thyroid secretion. That calcium may be involved is merely speculation. The points of importance are that simple goitre may occur without apparent precedent or accompanying fatigue: That it must be primarily of a compensatory nature; and therefore should not be operated without good reason. The most common cause of simple goitre, however, seems to be connected directly with fatigue and impairment of the general nuitrition in which that of the thyroid participates. With the relief of these attendant causative conditions the subsidence of the compensatory hypertrophy may be complete; or it may be incomplete, and scattered areas or one lobe may remain enlarged. Under the latter circumstances, as remarked before, it must be supposed that the natural outlet for the thyroid secretion has become blocked during the period of excessive function, which was normal in that the vitality of the gland had not been damaged sufficiently to cause it to produce an excess of the nucleoproteid portion of its output. The closure, probably mechanical, of the natural outlets for the thyroid secretion practically leaves only half of the gland to functionate. Then under any prolonged strain the automatic stimuli, delivered to the whole gland, quickly force the damaged portion to attempt to supply the demand, and the consequent proliferation of its epithelium leads to an excess of the injurious nucleoproteid material. Hence the logical procedure is not to administer antithyroid serum, but to excise the degenerated area and to assist the presumably insufficient residue by thyroid feeding and good hygiene until the requisite compensatory hypertrophy can take place. As little normal gland tissue as possible should be sacrificed. The administration of the specific antiserum should only inhibit the action of a damaged organ which is trying to do its duty, and while it may thus check exacerbations of thyroidism, the antiserum would ultimately do harm rather than good. There is, however, always some danger of what is here called "auto-activation" if the thyroid feeding is pushed too far.

The therapeutics of Graves' disease according to this theory depends upon the stage which the process has reached and involves primarily the condition of the thyroid. Some glands seem congenitally weak; in other words, the biochemical relations of the epithelium to iodine become disturbed with the slightest impairment of the general nutrition. Any unusual amount of automatic stimulation seems to cause the epithelium of these deficient organs to proliferate and produce both an excessive quantity of thyroid nucleoproteid and a poor quality of abundant thyroid globulin. In this class should be grouped the patients without any appreciable goitre yet with all the other signs of thyroidism and generally with a more or less distinct family history of disease connected with this organ. These cases are quite numerous and occur mostly in young girls about the age of puberty and represent the incipient stage of exophthalmic goitre. One or two injections of the antithyroid serum may be needed, but the indications are all for supporting rather than opposing the theoretically attempted compensation; the combined thyroid proteids administered alone or with some pancreatic preparation ought to yield the best results. To remove half of the gland in such a patient is an almost irreparable calamity. It is almost and not entirely irreparable because youth and the best of hygiene and careful nutritional therapeutics may surmount great obstacles and the proper compensation may eventually be regained.

As a general rule the more vigorous and robust the individual before the appearance of fully developed thyroidism and the earlier such an individual comes under observation the better is the prospect for operative success. This is apparently obtained by breaking both of the (theoretical) vicious circles, in that removal of the usual half of the gland and the subsequent enforced confinement to bed and good hygiene takes away the superabundant secretion and allows the chromaffin system, pancreas, liver, and thyroid to resume their normal relations. But if the convalescence is not carefully guarded relapse is almost a certainty. Later in the progress of the disease, however, when it is presumable that the thyroid secretion has become badly impaired in quality, radical operation should and does have a much worse prognosis. A half of a slightly damaged gland may with some hygienic and medicinal assistance functionate perfectly, but not when its vitality has become seriously injured. Under these conditions ligation of one to three of the largest afferent vessels and strict enforcement of rest may in course of time cause great improvement by cutting off the excess of auto-activation and frequent exacerbations of thyroidism; and so with the improvement of general nutrition that of the thyroid participates, and the gland may again become able to properly take up and utilize iodine. After this period has been reached radical operation might offer some hopes of success, but not before.

In the myxœdematoid stage of thyroidism no form of operation should be beneficial.

Case 23 (detailed on page 168) shows the doubt which always exists as to the outcome of partial thyroidectomy even in the early stages of typical Graves' disease. This experience can be interpreted in two ways: Either the apparent acute and fatal exacerbation of thyroidism after operation was produced by an excess of the thyroid nucleoproteid which was squeezed into the blood during the operative manipulation of the gland and thus over-activated the chromaffin system; or the fatality was not from so-called thyroidism but from an independent and unrestrained over-action of the chromaffin system. The universally activating thyroid globulin though of poor quality must have kept some of the pancreas from becoming quiescent, and thus theoretically must have exerted some inhibition upon the chromaffin system; but after removal of the thyroid there remained no inhibition of the self activated chromaffin system, and the latter produced the increasing tachycardia, and in the failure of both thyroid and pancreas the toxæmia which might be traceable to the liver. This explanation is conceivable from the experiments of Eppinger, Falta, and Rudinger, and does no violence to the hypothesis advanced above for the mechanism of Graves' disease. The possibility of the preponderance of the influence of the chromaffin system in the disturbance must always be taken into consideration. As the clinical history and the symptoms seem to be the same as when the thyroid may be assumed to be the principal factor, the most logical as well as the only way at present of determining the proper and safe therapeutic course to pursue lies in the experimental administration of the specific antithyroid serum. If the thyroid is the principal organ at fault and the true key to the situation, an injection of five or ten minims of the antiserum will either be entirely negative in its results or there will be within the next twenty-four or forty-eight hours some slight improvement in the subjective or objective symptoms. If there is no change in forty-eight hours a slightly larger dose can then safely be attempted. Rarely this may have to be repeated every other day for a couple of weeks before improvement can be detected. But if the chromaffin system can be assumed to be at the bottom of the disturbance and the thyroid only involved secondarily, so to speak, the antiserum will almost immediately or very soon aggravate all the symptoms and the apparent thyroidism will be intensified. By proceeding cautiously with the antithyroid serum this necessary experimentation is never dangerous and practically seems to be a most reliable guide as to what may be expected from radical operation. For in Dr. Beebe's statistics there have been nine deaths from an apparently acute exacerbation of thyroidism following partial thyroidectomy. These fatalities were all in cases which had failed to improve under a preliminary antiserum treatment. In the writer's personal and early experience there have been four cases which showed no improvement under the antiserum treatment and then sought surgical relief elsewhere with the result of only one death but of three failures to cure. In several later cases, however, after slight improvement under the antiserum, it has seemed justifiable to save time and expense by radical operation, and so far these patients have shown no ill effects and have proved perfect cures. The antithyroid serum can therefore be regarded as of considerable diagnostic and prognostic value, and when the chromaffin system may theoretically have a greater influence than the thyroid in a case of thyroidism the antithyroid serum should indicate the danger. If it alleviates any symptoms then radical surgery in competent hands is probably safe and may offer a speedier good result; but whether it is wiser for the future remains to be determined.

If the antiserum proves of therapeutic assistance it should be continued as long as improvement is perceptible, but the pancreas which is theoretically also at fault, should be constantly aided by the administration of this organ in some form in protected capsules by mouth or preferably by rectum or subcutaneously. Trypsin or the commercial preparation known as "holadin" and pancreatin or the nucleoproteid material of the pancreas should be tried, and generally one more than another will be found of some value though their effects are seldom striking or immediate. If the antiserum or the pancreas products are slowly beneficial more gain may sometimes be obtained by the cautious addition to the medication of gr. $^1/_{50}$ of the combined thyroid proteids, preferably from the sheep gland, as this contains more thyroglobulin than the pig gland. The thyroid feeding is supposed to "help out" the poor quality of the patient's thyroid secretion, but its administration must be stopped or postponed if any intensification of the existing thyroidism follows. If the antiserum after one or more trials proves injurious, and even in the early stages of the disease, as remarked above, this may occasionally happen, then the 1 : 1000 solution of the thyroid globulin can be tried in a five-minim dose subcutaneously once or twice daily, and be stopped if any intensification of the thyroidism follows. The thyroglobulin thus given is harmless and is almost a specific for the colitis and diarrhœa which often occur in the later stages of chronic thyroidism. But the frequent loose movements of the earlier period will be made more troublesome by its administration and can only be controlled by the antiserum. The pancreas medication is, however, almost always useful at any time, and seldom or never seems harmful. The thyroid nucleoproteid solution for subcutaneous administration may rarely prove beneficial in some myxœdematoid conditions, but in my experience has a very limited field. In these later stages of thyroidism, with a presumably exhausted thyroid and a chromaffin system whose secretory activity also may approach exhaustion though its nervous activity appears great, the adrenal nucleoproteid seems beneficial, especially if the blood pressure is high or if there is noticeable pigmentation of the skin.

The therapeutics of this peculiar disease are thus largely a matter of cautious experimentation in each case and seem to depend chiefly upon the vitality of the thyroid and its ability to properly take up and utilize iodine. To remedy this defect, the nutrition in general and that of the thyroid in particular, must be carefully fostered by good hygiene. The vicious circles which have theoretically become established must be broken by partial thyroidectomy or by ligation of not less than one nor more than three of the thyroid vessels at one sitting; or repeated injections of the antithyroid serum must be employed to check the abnormal activity of the thyroid epithelium and to neutralize its superabundant globulin product and thus break both vicious circles. But the antithyroid serum must not be pushed to the point of unduly damaging the vitality of the already weakened epithelium, or the automatic mechanism which controls the quantity of the thyroid product will compel the gland to overact worse than previously. Under these conditions which can only be ascertained by experimentation, the pancreas should be aided and also, especially in the late stages, the thyroid itself and possibly the chromaffin system.

The first two histories represent cases of "leaking retention cysts" of the thyroid.

Case 370.—Miss N., age 22, has noted a small goitre for five or six years. It first appeared after a period of rapid growth and hard study, and some nervousness and insomnia was remembered to be coincident with the diffuse enlargement of the neck. Later all symptoms disappeared, including the symmetrical goitre, but a localized tumefaction near the middle line persisted. In February, 1909, there was a sharp attack of tonsillitis which was accompanied by fever, a pulse rate of 130 to 150, throbbing heart action, nervousness and insomnia. With these disturbances the "lump in the neck swelled up" and caused slightly stridulous respiration. These symptoms gradually disappeared, but in March, after an automobile accident, the thyroidism was quite marked for some days. In April there was another recurrence, following or accompanying some digestive disturbance. This again subsided to recur at irregular intervals and for longer or shorter periods. The chief complaint was of throbbing and rapid heart action accompanied by some dyspnœa and insomnia, beginning without appreciable cause and generally during the night, and with this a marked feeling of weakness. During the attacks, which were becoming more frequent, the palpebral fissure seemed wider, but there was no true exophthalmos. There existed a sharply circumscribed globular tumor about 1½ inches in diameter (apparently in the right extremity of the thyroid) which felt like a rather tense cyst.

In June, 1909, under nitrous oxide and oxygen anæsthesia, this was excised. The right lobe was turned out on the neck and split open from behind; a globular tumor, sharply defined by a capsule, was enucleated from the surrounding gland tissue, which appeared normal. The recovery was uneventful and the patient returned to her home after ten days.

Before the operation the administration of the 2 per cent. tablets of combined thyroid proteids was followed almost immediately by tachycardia, nervousness, insomnia and weakness; afterwards their administration seemed rather to slow than to increase the pulse rate and quite decidedly to improve the sleep, strength and weight, with a gain of 25 pounds in the next three months.

PATHOLOGIST'S REPORT.

The tissue examined is a well-circumscribed mass surrounded by a definite capsule within, which projects several finger-like masses of thyroid tissue. These are surrounded by a little thin yellowish fluid which escapes on opening the capsule of the tumor. The projecting masses resemble papillary adenomata in the gross, arising from the capsule, but microscopically they fail to show neoplastic characters. They are composed of many small alveoli with pale colloid or none, supported by stroma which is hyaline and infiltrated with thin colloid. There are a few small, very vascular areas such as are seen in active Graves's disease, but the cells lining most of the alveoli are small, transparent and with very small nuclei. There are many widely dilated spaces, probably dilated alveoli, which apparently communicated with the general cavity surrounded by the main capsule. These spaces are empty and no definite colloid was present in any portion of the mass.

Case 335.—Mrs. D., 64 years of age, first noted a goitre twelve years previously while caring for her husband who was dying slowly of cancer. Anxiety checked her appetite and she was unable to obtain a proper amount of sleep for months and suffered greatly from physical and nervous strain. After his death she was afflicted for a considerable period with nervousness, insomnia and palpitation of the heart after the slightest excitement or fatigue, and a " lump " in the neck appeared. Then all symptoms gradually subsided, including the goitre on the right side of the neck but that on the left shrank only to a slight extent. Following this there was a long interval of good health, though the goitre remained unchanged until July, 1907, when she began to grow somewhat stouter, and after excitement or exertion suffered again from palpitation, nervousness and insomnia, and dyspnœa which soon became accompanied by stridulous respiration. The freedom from symptoms obtained by sedatives and repose grew shorter and the exacerbations of thyroidism longer and more distressing, and relief—especially from the difficulty in breathing—seemed imperative. When quiet, the only abnormality to be detected was a soft left-sided goitre about the size of an orange, pressure upon which caused stridulous respiration, and this was increased to almost complete obstruction by raising the left arm above the head. The right lobe was not appreciably enlarged.

In February, 1909, under nitrous oxide and oxygen anæsthesia the enlarged left lobe was excised by an L-shaped excision. There was a soft vascular portion situated deep in the neck behind the clavicle and sternum, and the profuse hemorrhage which followed its delivery onto the surface looked like a laceration of one of the large thoracic veins. The ensuing necessary rapid sponging and clamping showed well the possibility of injury to the recurrent laryngeal nerve which might be unavoidable under these circumstances. An uneventful recovery, however, took place with complete relief of all symptoms. During convalescence it was evident that exertion or excitement produced a slight feeling of pressure or constriction in the region of the remaining lobe of the thyroid, though during the operation it was exposed and presented no noticeable abnormality. This sensation was relieved entirely, as was the accompanying slight constipation and feeling of indigestion, by administration of the 2 per cent. tablet of the combined thyroid proteids previously described. This pro-thyroid treatment has been continued with entirely satisfactory and apparently beneficial results.

PATHOLOGIST'S REPORT.

The tissue examined is composed of an excessive number of small regular alveoli deficient in colloid, among which are scattered a number of slightly distended alveoli. There are wide variations in the staining quantity of colloid between very light staining areas and very dense and opaque masses. In some areas there is much interstitial colloid in which lie small isolated alveoli. This appearance is similar to that of the myxœdema thyroid. There are several irregular cysts filled with colloid.

This thyroid resembles that of myxœdema more than that of typical Graves's disease.

The following histories narrate instances of the specific treatment of thyroid disease:

Case 1.—Miss F., age 27, presented severe typical exophthalmic goitre in the early stages though of two years' duration. Pulse 130–160; large symmetrical elastic goitre. Largest circumference of neck 14 inches; respiration 26–28; moderate exophthalmos; marked tremor; moist skin. In April, 1905, she received three injections of the antithyroid serum during one week and no other treatment subsequently except a hygienic mode of life. There followed a marked improvement after the first injection and while she was by no means immediately cured by these injections, the change for the better was thus started. During the following summer all traces of the disease except the goitre disappeared, and after one year not even the goitre existed. This woman remained well and without any signs of disease until June, 1909, when for several weeks she was compelled during a period of hot weather to work early and late, often going without meals and sufficient sleep. She then noticed a recurrence of the tachycardia with "thumping" heart and insomnia, and immediately applied for relief. There was no goitre nor exophthalmos, and the above were the only signs of thyroidism. The only change made in her mode of life were 12 hours out of 24 to be passed in bed and regular periods for eating; for medication she was given 6 grains of a pancreatic preparation (Holadin) in protected capsules an hour before meals and at night. At the end of two weeks the pulse had dropped from an average of 110–115 to 75–80 and the insomnia and nervousness had disappeared. At present (four months later), there are no signs of any disease.

Case 82.—Mrs. L., aged 39, presented typical severe exophthalmic goitre of two years' duration. Marked exophthalmos, large symmetrical firm goitre, largest circumference of neck

15½ inches; pulse 130–140; respirations 30–35; emaciation; moist somewhat pigmented skin; frequent soft stools; weakness, nervousness, insomnia and distressing thirst. From June to December, 1907, injections of antithyroid serum were given at first every other day, then twice and finally once weekly. There was gradual improvement, and on November 30, 1907, the exophthalmos and goitre were decidedly less and the patient noticeably improved. Neck 13½ inches in circumference; pulse 100–120. In December the injections of antithyroid serum seemed harmful rather than beneficial, the pulse began to rise, the weakness increased and the appetite failed; a diarrhœa with light-colored stools developed and the skin instead of being moist was noticeably dry. The antiserum was therefore stopped and a tablet containing one-fiftieth of a grain of the combined thyroid nucleoproteid and globulin from sheep's glands was given by mouth four times daily. An almost immediate improvement in all symptoms followed, and in January, 1908, her physician considered her cured, though I have placed her in the "improved" class as there are still traces of thyroid disorder which suggest a myxœdematoid condition. At this period of our experience the differences between the nucleo-proteid and globulin were suspected but not clearly recognized.

Case 126.—Mrs. P., aged 28, presented typical rather severe exophthalmic goitre of about two years' duration, but the color of the skin was very white and it was dry except after exertion. Some œdema of the legs; the hæmoglobin was 60 per cent.; symmetrical firm goitre; circumference of neck 13½ inches; pulse 120–130. In December, 1907, two injections of antithyroid serum were given with intensification of all the symptoms and in addition a rise of temperature to 103° F. After an interval the exacerbation subsided and iodine in the form of one grain of iodide of iron pills, was tried. At first there was some improvement, but the goitre enlarged and hardened until the neck measured 14 inches in circumference and the patient complained of a sensation of constriction of the neck. A week later there was a violent attack of gastro-enteritis and another exacerbation of thyroidism. After its subsidence the combined sheep thyroid nucleoproteid and globulin was tried by mouth cautiously, and stopped, as this medication increased the tachycardia and diarrhœa. The normal human thyroid nucleoproteid was next given in very small dose subcutaneously; but it increased the nervousness and tachycardia, and finally the solution of the normal human thyroid globulin was administered. The night following this injection the patient slept nine hours for the first time in weeks and the following morning the pulse had dropped from 130 of the previous evening, to 96. This remarkable improvement, however, did not last through the day and the next night was poor, though a little better than usual. The injection was therefore repeated though with not quite as good a result as the first time. Improvement, however, gradually followed daily injections of this normal human thyroid globulin. In May, 1908, it was stopped, as the patient seemed entirely well though somewhat weak and anæmic. Pulse 80, no exophthalmos; no goitre; neck 12 inches in circumference; hæmaglobin 85 per cent. A slight relapse occurred in July, 1908, but was checked by a repetition of the injections. Another slight exacerbation of subjective symptoms in October, 1908, was checked within one week by giving one-fiftieth of a grain of sheep thyroid globulin by rectum every six hours. Since then there has been no recurrence and there is now no sign of disease.

Case 114.—Mr. McG., aged 53, had had typical severe exophthalmic goitre seven years previously; under rest cures and a valetudinarian mode of life the disease had passed through the chronic stage and reached the myxœdematoid type in November, 1907. Exophthalmos slight, with puffiness about the eyelids and malar prominences; yellowish brown dry skin with dry, brittle hair on the scalp; puffy supraclavicular pads; stiffness of the fingers; small hard goitre; pulse rate 120–130 on exertion, 90–110 while at rest; apparent general good nutrition but complains bitterly of nervousness, tremor, insomnia, weakness and fermentaive indigestion. An experimental injection of thyroid antiserum produced great prostration and diarrhœa and intensification of all symptoms. After an interval during which recovery to the previous condition occurred, the sheep thyroid nucleoproteid and globulin were tried by mouth without benefit and with an increase in pulse rate and some diarrhœa. Again after another interval the human thyroid globulin solution was tried without benefit except some improvement in the gastro-enteric symptoms; but with this there occurred an exaggeration of the nervous excitability and insomnia and the pulse rate was no better. The normal human thyroid nucleoproteid solution was then tried with no ill effect and some immediate improvement in the insomnia. The dose of this 1 : 1000 solution had to be kept at not over 5 minims once a day, as increasing it produced tachycardia; but by perseverance a gradual steady improvement in all symptoms took place until in March, 1908, the myxœdematoid signs had practically disappeared and the pulse after a brisk walk was between 80 and 90. The only evidence of disease was a considerable weakness and inability to withstand ordinary fatigue. This patient relapsed several times subsequently, always beginning with a gastroenteritis apparently produced by eating heartily when fatigued, and each relapse has been checked and corrected by the same normal human thyroid nucleoproteid injections.

These relapses caused him to seek other assistance and in August, 1908, three of the thyroid vessels were ligated under local anæsthesia by Prof. Kocher in Berne. There was a stormy convalescence, according to the patient's report, and no appreciable improvement. Benefit with the thyroid nucleoproteid was then again obtained, but another relapse preceded by tonsillitis and gastro-enteritis occurred in September, 1909. This was followed by evidences of severe nephritis accompanied by albumin, casts and blood in the urine, but all the signs of thyroidism disappeared. Death followed in uræmic coma, in November.

This terminal nephritis is much more common than glycosuria and seems about equally fatal.

Case 287.—Miss R., age 31, had always been "nervous" and subject to "bilious" attacks. In November, 1908, she presented mild typical symptoms of exophthalmic goitre which had been gradually becoming more noticeable during the previous year. Exophthalmos was very slight. There was a small firm goitre; pulse rate 120; well-marked tremor and extreme nervous excitability. Hæmoglobin 85 per cent., leucocytes 9000, lymphocytes 32 per cent. From November, 1908, to March, 1909, first the antiserum and then prothyroid treatment combined with pancreas feeding produced very slight improvement. On March 12, 1909, the superior thyroid vessels were tied under nitrous oxide—oxygen anæsthesia—with almost immediate benefit, especially in the nervous excitability. The pulse rate instead of averaging 110 dropped to 90 and the previous frequent exacerbations of thyroidism ceased. The preparations of pancreas were then administered. Trypsin or holadin seemed to excite headache almost immediately; pancreatin or pancreatic extract seemed to cause over-action of the heart with a subjective sensation of thumping but no appreciable increase of pulse rate; the pancreas nucleoproteid, however, given in one-half grain doses three or four times daily appeared to increase the strength and weight, and there was a gain of 15 pounds soon after it was begun. The combined thyroid proteids before the operation always excited the pulse rate. A few weeks after the ligation of the vessels the combined thyroid proteids were given with the pancreas nucleoproteid and seemed beneficial. In June, 1909, the pulse rate averaged while at rest 80–90; the blood examination was normal; there was no exophthalmos; and the goitre was appreciably softer and smaller, although the neck measurement showed no change because of the gain in flesh. This patient still shows signs of the disease in the nervousness and easily excited tachycardia, and so is classified as only improved.

Case 210.—Miss C., aged 22, presented typical severe exophthalmic goitre of about six months' duration. There was excessive nervous irritability and insomnia and only a slight change for the better could be noted after two weeks' trial with the antiserum. On July 24, 1908, the right or larger thyroid lobe and the isthmus were therefore removed under ether. Recovery was uneventful and at the end of a week the subjective distress and insomnia had disappeared. After four weeks in bed there was no discoverable abnormality except the cicatrix and slightly enlarged left lobe. In October, 1908, this patient returned to Finland for a year's rest and now appears perfectly normal.

Case 23.—Miss M., age 28, presents typical symptoms of exophthalmic goitre of about two years' duration; firm symmetrical goitre; moderate exophthalmos; pulse rate 120–140; moist skin; blood and urine examination negative.

On March 17, 1906, I watched the removal of nearly the entire thyroid gland. A portion representing about one-half gram of tissue at the upper end of the right lobe was left and was apparently supplied by a small branch of the corresponding superior thyroid artery. The operation was performed quickly and well and no unusual traumatism was inflicted upon the excised gland. This patient left the table with only a slightly increased pulse rate, but it rapidly rose and was accompanied by high fever, great restlessness and nervous excitability. At midnight a considerable dose of a potent antiserum was administered; but though a careful watch was kept upon the pulse rate no change could be detected and the patient died about 24 hours after the operation with a pulse which had steadily increased in frequency and weakness. The temperature reached 105, respiration 40 and labored, and extreme nervous excitability and delirium.

Was this a death from thyroidism or from an over-acting and self-activating chromaffin system?

Case 143.—Mr. C., age 62, in February, 1908, presented typical exophthalmic goitre of about two years' duration. The goitre and other symptoms had been first noted after a severe operation for gall-stones. It was firm, elastic and symmetrical; greatest circumference of neck 16 inches; noticeable exophthalmos; pulse rate 100–120 and somewhat irregular; skin moist, marked tremor and nervous excitability; blood and urine examination was negative. The antiserum was first tried and produced so much prostration without noticeable improvement that it was not repeated. The combined thyroid proteids intensified all the symptoms. Iodine was then administered in the form of one grain iodide of iron pills given after meals, and an almost immediate subjective and objective gain became apparent. On April 15, 1908, he had gained on this medication alone 22 pounds; the pulse rate was 72; there was no exophthalmos and no goitre; the neck measured 15 inches in its greatest circumference; there was no sign of disease and there has been no relapse.

Case 420.—Mrs. G., age 35, presented severe typical exophthalmic goitre in the later stages although the disease had been recognized only during about one year. She had received the antithyroid serum elsewhere and at first been benefited but continued at work, and in August, 1909, the disease compelled rest in bed in Bellevue Hospital. There was a large, firm symmetrical goitre; greatest circumference of neck 15 inches; pronounced exophthalmos; respiration 28–30; pulse rate 120–140; hæmoglobin 90 per cent.; leucocytes 11000; lymphocytes 28 per cent. of this; blood pressure 150 mm. Hg; noticeable pigmentation or bronzing of the skin which was like that of advanced Addison's disease; a cutaneous test for tuberculosis proved negative; great emaciation and weakness. The antiserum was tried and intensified all the symptoms although there was a transient drop in the pulse rate and respiration about 12 hours after the injection. The thyroid proteids proved equally useless or injurious. Pancreas feeding proved negative. On August 12, 1909, the subcutaneous administration of 10 minims of a 1 : 1000 solution of (human) adrenal nucleoproteid material was begun and continued once in 12 hours and was followed by an almost immediate improvement. On

August 18 the blood pressure was 110 mm. Hg; the pulse rate 80–90; respiration 22–24; leucocytes 9000 and lymphocytes 18 per cent. of this; the goitre was softer and smaller; greatest circumference of neck 14 inches; eyes less prominent and the cutaneous pigmentation had noticeably faded. She then insisted on returning to her home and I have since heard she has relapsed as was to be expected. The important facts in this case were the suggestion of suprarenal disease in the cutaneous bronzing; the high blood pressure; and the relief of this and other symptoms by the adrenal nucleoproteid alone.

Case 315.—Miss D. B., aged 17, always a delicate, nervous child, began to show the unmistakable signs of exophthalmic goitre after the death of her father and during a period of hard study six months ago. Under a careful regimen of rest in bed for half the day the widening of the palpebral fissure, the slight goitre and pulse rate of 110–120 at least did not increase.

In February, 1909, she was placed upon one-fiftieth grain of thyroglobulin by rectum three times daily and showed a slight improvement in the course of two months. In April the pulse ranged between 90 and 100, the goitre was smaller and softer and the eyes normal but tachycardia was easily excited by emotion or fatigue and there was some fermentative indigestion. On May 3 the thyroglobulin was stopped and a suppository containing five grains of trypsin was given by rectum morning and night. When arising on the day following this change the pulse which had not been below 90 for months, was counted at 62, and later without rising in rapidity became somewhat irregular. The dose of trypsin was then reduced to three grains twice daily and though the pulse continued at 75 at the end of a week slight enlargement of the thyroid was noted and the medication was changed to one-fiftieth grain of the combined thyroid proteids by mouth in protected capsules three times daily. Under this treatment the goitre and other symptoms gradually disappeared and at present there is no sign of disease.

The noticeable feature in this case was the marked and immediate effect of trypsin upon the tachycardia.

Case 151.—Mr. P., age 44, gave a history of having been treated for "diabetes" and apparently cured in 1904. In October, 1907, he began to suffer from typical exophthalmic goitre and in November showed in addition a noticeable bronzing of the skin. Between November, 1907, and February, 1908, he was treated first with the antithyroid serum and later with the administration of the combined thyroid proteids and finally iodine alone; the symptoms disappeared with the exception of a goitre of the right thyroid lobe, some weakness and the cutaneous pigmentation or bronzing. In March, 1909, after a period of hard work as a travelling salesman the symptoms of Graves's disease recurred with considerable enlargement of the thyroid, a deepening of the pigmentation and polyuria in which there was 1 per cent. of glucose. The antiserum checked all the objective symptoms and decreased the glycosuria to about 0.1 per cent., but great prostration and weakness followed. April 12, 1909, under nitrous oxide and oxygen anæsthesia, the right or more enlarged lobe and isthmus of the thyroid were excised. Recovery was uneventful and there was a prompt subsidence of the thyroidism, and though the percentage of glucose rose to 0.5 per cent. at first, at the end of five days it had disappeared. Later, when out of bed, traces of glucose could be detected from time to time and various preparations of pancreas were administered by rectum. It was remarkable that all except trypsin produced promptly a feeling of heart thumping and constriction of the neck, and with this there was some acceleration of the pulse and perceptible swelling of the remaining left thyroid lobe. But 5 grains of trypsin given in suppository three times, then twice, daily, seemed to relieve the subjective symptoms, slow the pulse and soften the goitre. Furthermore, the trace of glycosuria promptly disappeared under its administration. This medication and all restraint in diet (sugar alone had previously been abstained from) was abandoned in July, as every sign of disease except some bronzing of the skin had subsided, but in August he complained of some "rheumatism" or neuralgic pains in the legs and a slight increase in the size of the thyroid and in the rapidity of the pulse rate (90), and 0.5 per cent. of glucose was again found in the urine. Three grains of trypsin were then given by mouth in protected capsules and a diet (excluding sugar only) was instituted and the condition returned to normal within five days. At present (September, 1909) there is no goitre nor exophthalmos, the pulse rate averages 76–80 but the color of the skin is noticeably darker than it should be; there is no glycosuria nor polyuria.

Case 43.—Miss N. B., aged 28, noted the first typical symptoms of exophthalmic goitre in January, 1905, while serving her novitiate as a trained nurse. In June, 1906, the condition was that of rather severe Graves's disease; pulse 130–150; pronounced exophthalmos; large goitre and emaciation. Under antiserum treatment she had entirely recovered in December and gained 40 pounds in weight. She remained without sign of disease until May, 1909, when there developed quite suddenly polyuria amounting to about 80 ounces in 24 hours; marked thirst and 7 per cent. glucose and considerable acetone and diacetic acid were present. Strict diet was instituted and 30 grains of a pancreatic preparation (holadin) in protected capsules was given daily in divided doses. There was an immediate improvement in all symptoms. There had been and were none of thyroidism and the pulse rate averaged 60–65, and on June seventh 40 ounces of urine were passed without any trace of glucose. Experiment showed that both the strict diet and the pancreatic feeding (in protected capsules or by rectum) were necessary to maintain the freedom from glycosuria. Without the pancreatic feeding traces of sugar and polyuria become apparent within 24 hours even if the strictest diet was maintained. About 6 grains daily of the pancreas nucleoproteid given by rectum seemed as efficient as 30 grains of the holadin preparation. After a period of rest and good hygiene combined with strict diet and the pancreas feeding she had no symptoms and resumed work as a trained nurse about August 1. On September 9 she returned and for the past few days had voided an average of 130 ounces of urine daily. The examination showed a specific gravity of 1040 and approximately 5 per cent. glucose. Rest, strict diet and pancreas feeding made no appreciable improvement and she rapidly lost ground and died in diabetic coma on September 30.

NOTE.—In previous communications on this subject which included a theory for the function of the thyroid gland, its secretion was supposed as above to possess two elements, one the nucleo proteid, to directly stimulate the cardiac and respiratory centres in the medulla, and the other the thyroid globulin to stimulate or activate all other organs and tissues. But this universally activating property of the thyroid globulin was supposed to exert its effects through the control of oxidation in which the thyroid globulin played the part of an oxidative enzyme or, in its ultimate analysis, a substance lying between the oxygen of the air and the hæmoglobin of the red corpuscles. This is too radical a departure from the accepted teachings of physiology to be advanced without more proof, and although there are some grounds for connecting the thyroid with oxidation, it is probably less erroneous to consider the thyroid globulin or colloid material as possessing generally "activating" properties rather than as governing some specific chemical process.

SUGGESTIONS FOR THE OPERATIVE CORRECTION OF SYPHILITIC AND OTHER DEFORMITIES OF THE NOSE.*

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THE surgery of the external nose deserves more attention than is usually given it. The cosmetic value of the organ is very great and the possibilities of relief in cases of deformity are apparently not appreciated to their full extent by the medical profession or the public. The satisfaction often evinced by patients after seeing the facial improvement obtained by slight operations and the patience with which others will submit to a series of complicated and painful procedures are evidence of the importance of this kind of surgical endeavor. Very much can be gained by operative reconstructions without resort to bizarre methods.

Congenital absence of the nose is a rare deformity which may require surgical attention if the infant survive the early periods of human life. Congenital fissure of the nose may also need plastic repair.

The most common congenital defect of the external nose is the broadening of the nostril, due to spreading of the ala, found in connection with harelip and cleft palate. This deformity is to be modified by very early operation upon the cleft in the bony roof of the mouth, combined with a later plastic adjustment of the alar cartilage and upper lip. Careful correction of the nasal deformity is often neglected by operators on clefts of the upper lip.

Punitive losses of the external nose were common in the ancient and mediæval worlds and are still frequent in oriental countries. Such traumatisms concern as a rule only the integument and cartilages below the nasal bones. Hence they are repaired by plastic operations more easily and satisfactorily than deformities resulting from syphilis, gunshot injuries, or extensive operations for tumors. These causes of disfigurement often involve the bony and cartilaginous structures within the nasal chambers as well as the projecting external nose. When the nasal bones constituting the bridge of the nose have been lost or the supports of the external cartilaginous nose have been destroyed by syphilis, the reconstructive problem is much more difficult than when the cartilaginous nose has been merely sliced off by the sword of an antagonist or the knife of an avenger.

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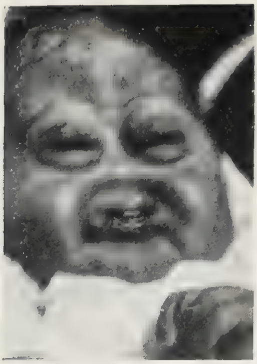
* Read before the American Surgical Association, June 4, 1909.

The inherent trouble in all extensive nasal reconstructions is the obtaining of sufficient permanent projection from the surface of the face. It is an easy task to put a flat mass of skin and fascia in the region of the nose. It may be not very difficult to give it the prominence and general shape of a nasal organ. To maintain permanently the shape and prominence of the new nose, despite the contracting power of scar tissue, is the surgeon's difficulty. To obtain nares which will remain patent and a columella which will resist deformity from postoperative contraction is often almost impossible. When the ulcerative process of syphilis, tuberculosis or malignant disease or when gangrene from burns, frost-bite or caustics has destroyed the cutaneous surface around the nose, it becomes necessary for the surgeon to transfer or transplant healthy tissues from other regions to replace the scar tissue.

It is gratifying to find that inherited syphilis of the nose seems to be less apt to involve the skin than the acquired disease. Unfortunately both forms of this loathsome affection destroy the bones and cartilages, upon which the contour of the external nose depends. Much nasal deformity and mental suffering may be avoided by the early recognition of syphilitic lesions of the nose and the prompt institution of efficient specific treatment. I have never been convinced of the propriety of waiting for the development of secondary lesions before treating suspicious sores with mercury; nor can I

FIG. 1.



Congenital absence of external nose associated with double harelip and cleft palate. No nostrils and no evidence of external nose were present except a slight elevation below the frontal spine, which was evidently the two nasal bones. Child died when a few days old. (Patient of Dr. Delno E. Kercher.)

FIG. 2, *a*.

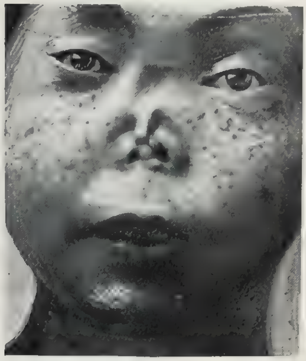
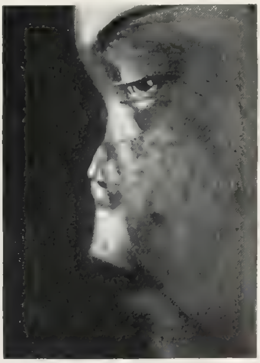
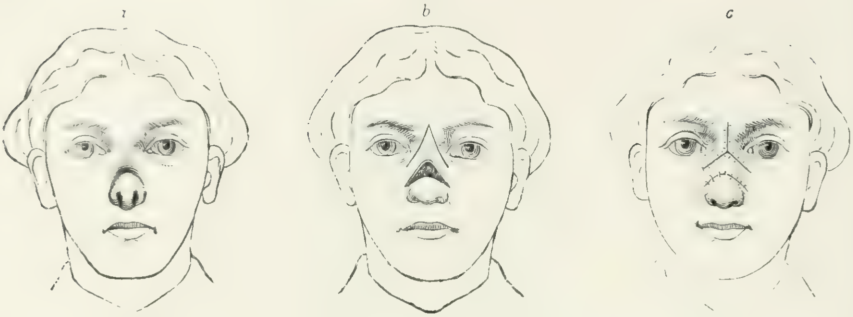


FIG. 2, *b*.



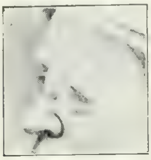
Photographs of a sunken nose from necrosis of cartilages and internal bones in infancy improved by operation. (J. B. Roberts.)

Fig. 3.



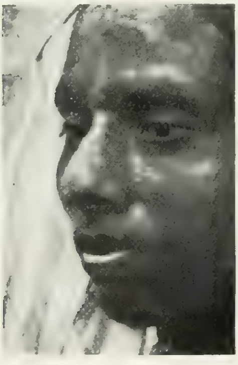
Method of correcting a sunken syphilitic nose of moderate severity.

Fig. 4.



Lateral view of patient operated on by method shown in Fig. 3.

Fig. 8.

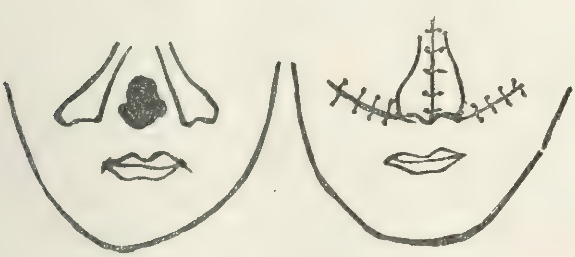


Photograph of a patient operated upon by Major Henry Smith, of the Indian Medical Service, by his modification of Keegan's method. (Courtesy of Col. D. F. Keegan, M.D.)

understand the folly of treating tertiary lesions with small and therefore inefficient doses of mercury and potassium iodide.

Deformities of the nose and obstructions to proper ventilation of the nasal chambers and to respiration will be much lessened in number, if, after blows and falls upon the face, children and others are carefully examined for fractures and dislocations of the nasal bones and cartilages. The early reduction of displaced structures will prevent disfigurements, which may not offend the eye till swelling has disappeared or the child has increased in age. Portions of the nose accidently cut off should be immediately replaced and sutured after aseptic cleansing. Their permanent union may sometimes be obtained, if the parts are kept warm.

FIG. 5.



Serre's method of rhinoplasty, occasionally available.

Rhinoplastic operations are important because of the cosmetic value of a comely nose. The psychic effect of a knowledge of marked facial disfigurement, especially if due to syphilis, is sufficient to affect the patient deleteriously in both disposition and earning capacity. Suits to recover damages for nasal disfigurement indicate that a distinct commercial value is attached to comeliness of countenance.

Total rhinoplasty should mean reconstruction of the whole nose below the frontonasal suture, but the term is often used when the loss of the organ begins below the nasal bones. Pedunculated flaps for the reconstruction may be taken from the patient's arm, forehead or cheeks. Brachial flaps require the arm and the head to be held in apposition by gypsum bandages or other retentive apparatus for about two weeks. A flap cut on the upper arm or forearm may be permitted with advantage to contract and thicken by cicatricial changes or be moulded somewhat into shape before the arm and head are approximated and the flap sutured in the nasal region. Lexer [1] has carved a nose from the condyles of an amputated femur, bored holes for nostrils, planted the bony mass under the skin of the forearm and subsequently transplanted it upon the face.

The frontal method has the advantages that it requires no restraint in the patient's posture and that strips of periosteum or bone cut with the flap from the forehead may be imbedded in the new nose with comparative ease and considerable advantage. There are numerous modifications of these osteoplastic methods. The scarring of the frontal region is a disadvantage, but this may be minimized by aseptic methods and skin grafting.

In partial rhinoplasty pedunculated flaps are often taken from the cheeks. If cut in the direction of the nasolabial furrows such flaps, even when large, leave comparatively little objectionable scarring. The incidental diminution of the prominence of the cheeks increases the relative projection of the plastic reconstruction of the nose and is therefore a cosmetic benefit.

Superimposed flaps may be necessary in nasal reparations, in order to give to the structures sufficient thickness and rigidity to retain nasal projection.

Free flaps of integument from the inner surface of the thigh or arm may be utilized, if careful asepsis is obtained and maintained during the transplantation and after dressing. Such nonpedunculated flaps cannot be used with much hope of success, when the raw surfaces or edges are subjected to direct communication with the nasal chambers. Infection is then too probable.

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[1] Lexer, Verhandl. der Deutsch. Gesell. für Chirurgie., 1908, ii.

Portions of cartilage taken from the patient's ribs or ear, pieces of bone from the forehead, tibia, ulna, ilium, a finger or a toe, or strips of bone or periosteum from a rabbit's femur may be implanted in the soft tissues used to repair the nose. These if aseptic become incorporated and may give permanent rigidity to the newly made nose. Such organic implantations are preferable to inorganic implantations or supports of celluloid or metal.

Improvement in shape of sunken or saddle noses may be obtained by the injection under the integument of paraffin or paraffin mixed with other materials. This wax-like material may be injected while hot enough to be fluid and then moulded with the operator's fingers into the desired form before it has time to cool. I use material with a melting point of about 110° F. A good hypodermic syringe with a rather large needle is all that is necessary for this little operation. Careful asepsis is essential and great care should be taken not to implant too much paraffin. It must be injected under, not into, the skin. Embolism of the artery of the optic nerve, sloughing of the skin and other mishaps from this little rhinoplastic

FIG. 6.

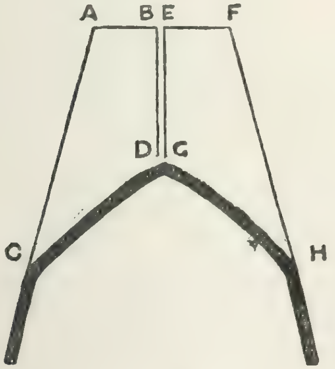


FIG. 7.

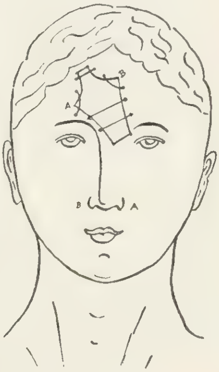


FIG. 6.—Diagram of Keegan's operation for rhinoplasty. The flaps C A B D and G E F H are dissected from surface of nasal bones and bent downward as if on hinges at C D and G H.

FIG. 7.—D. F. Keegan's method of cutting the frontal flap and applying the sutures to the frontal wound. (From Keegan's Rhinoplastic Operations.)

operation must be remembered as possibilities, and be carefully avoided.

The method of Keegan, whose service in India gave unusual opportunity for practical experience in dealing with mutilations of the nose, is probably the best rhinoplastic operation, when the nasal bones and the skin covering them have been preserved.

The operator first dissects from above downwards two flaps from the surface of the nasal bones and turns these down as on a hinge situated above the lower border of the bony nasal bridge. This gives a cutaneous surface towards the open nasal chambers and a raw surface from the root of the nose to its proposed tip.

An oblique frontal flap is then cut with its pedicle near the inner canthus of one eye, so that it may be nourished by the angular artery. The alæ and columella are provided for in forming this flap.

The size and exact shape of this frontal flap have been previously determined by cutting a piece of a flexible leaf to meet the special requirements of the deformity. This is copied in paper and the paper fastened to the skin of the forehead, before the knife, which marks out the flaps, is used. The flap is then raised, its pedicle twisted, and sutures are used to fasten it over the bared nasal bones and the turned down flaps covering the opening into the nose. A pit is made above the middle of the upper lip to receive the projection forming the columella, and the wounds on the side of the nose are deepened and lengthened to receive the edge of the flap from the forehead. The frontal wound is closed by sutures and with grafts made from any excess of tissue removed from the nasal or frontal flaps. Drain tubes are kept in the nostrils for a few days to maintain patency. The pedicle is divided in ten or fourteen days.

Instead of trimming away the median margins of the everted nasal flaps, which are voluminous, Henry Smith splits the remains of the nasal septum, inverts these median edges into the nasal cavity, and stitches them to the respective sides of the split septum. He thus creates a new septum and columella, and lines more of the interior of the new nose with skin.

If the septum and columella thus made are not sufficiently rigid a strip of cartilage, cut from the end of one of the patient's costal cartilages, may be subsequently thrust into the new partition to correct its flaccidity.

Fig. 9.

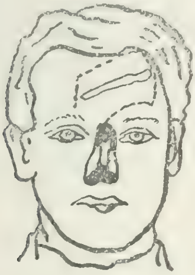
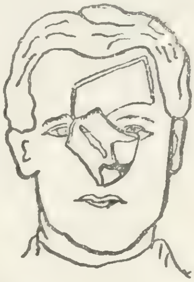


Fig. 10.



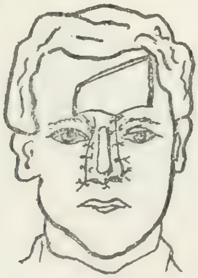


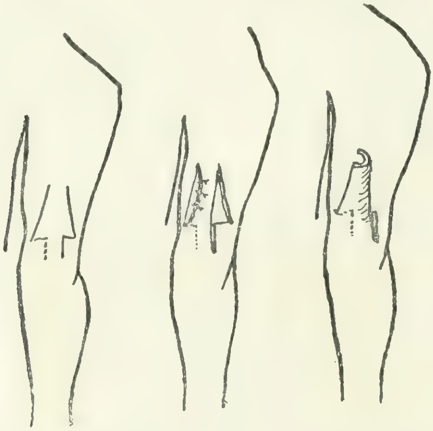
Fig. 11.

Fig. 9.—Charles Nélaton's method of giving rigidity to the frontal flap by previous implantation of a piece of the eighth costal cartilage under the periosteum of the forehead.
Fig. 10.—Eversion and modelling of the frontal flap in Nélaton's method.
Fig. 11.—The new nose, formed from a frontal flap and implanted cartilage, sutured to the cheeks and lip. (La Rhinoplastie, Nélaton and Ombrédanne.)

A valuable method of rhinoplasty is that of Charles Nélaton. He excises nearly the entire length of the cartilage of the eighth left rib, and trims its end, for about 2.5 centimetres, down to a thickness of 3 millimetres. This strip of cartilage he notches where it is expected to make the point of the nose. Then he thrusts it into a horizontal tunnel between the bone and periosteum of the forehead. In two months the cartilage becomes vitally connected with the surrounding tissues. The cicatricial borders of the nasal stump are then pared loose, making three flaps. These are turned downwards and inwards, and are sutured together so as to close more or less completely the upper part of the gap left by the loss of the external nose. The raw surface of these flaps presents forwards.

An irregularly quadrilateral flap is then cut from the forehead, with its pedicle at the inner border at the right eyebrow, containing the transplanted costal cartilage in its middle line. This flap is raised from the bone, carrying with it the entire periosteum and the implanted costal cartilage. It is twisted downwards and sutured on top of the nasal flaps just mentioned. By appropriate modelling with stitches an acceptable nose with alæ, columella and nostrils is formed.

FIG. 12. FIG. 13. FIG. 14.



Dieffenbach's method of modelling brachial flap before transferring it to the face.

The frontal bone may lose a thin layer of its surface by necrosis, because its periosteum has been removed; but when granulation has occurred Thiersch skin grafts are applied and the final scarring is said to be not very deforming.

In brachial rhinoplasty the flap for the new nose may be cut from the upper arm or the forearm; or a pedunculated flap from the chest or abdomen may be grafted upon the

FIG. 15.

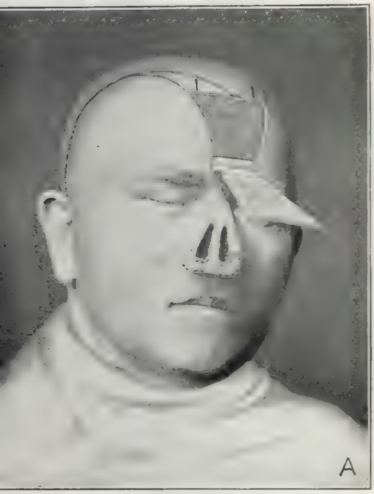


FIG. 16.

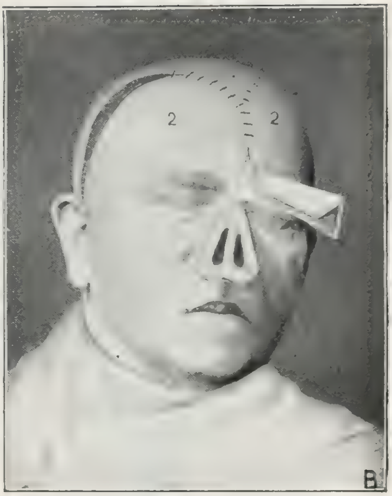
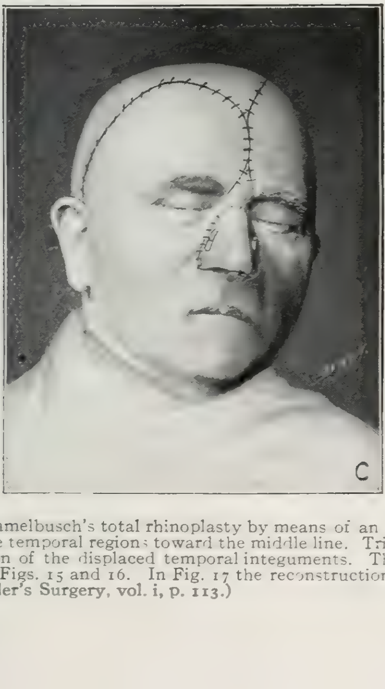
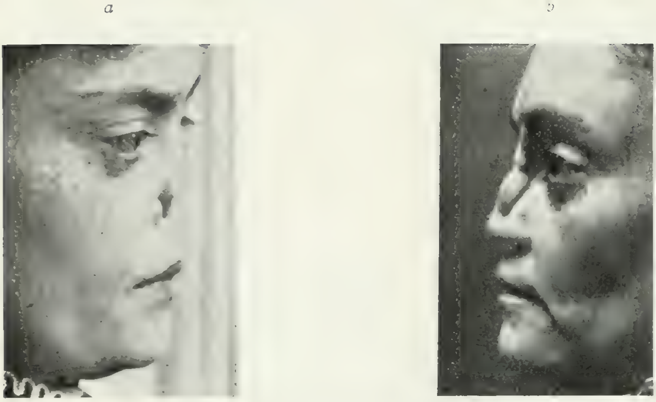


FIG. 17.



GS. 15, 16, AND 17.—Schimmelbusch's total rhinoplasty by means of an osteoplastic frontal flap, followed
al sliding of the skin of the temporal regions toward the middle line. Triangular areas of skin are removed
ig. 15 to permit apposition of the displaced temporal integuments. The new columella is made from the
of the alæ as shown in Figs. 15 and 16. In Fig. 17 the reconstruction is shown as it appears after the
have been applied. (Fowler's Surgery, vol. i, p. 113.)

FIG. 18.

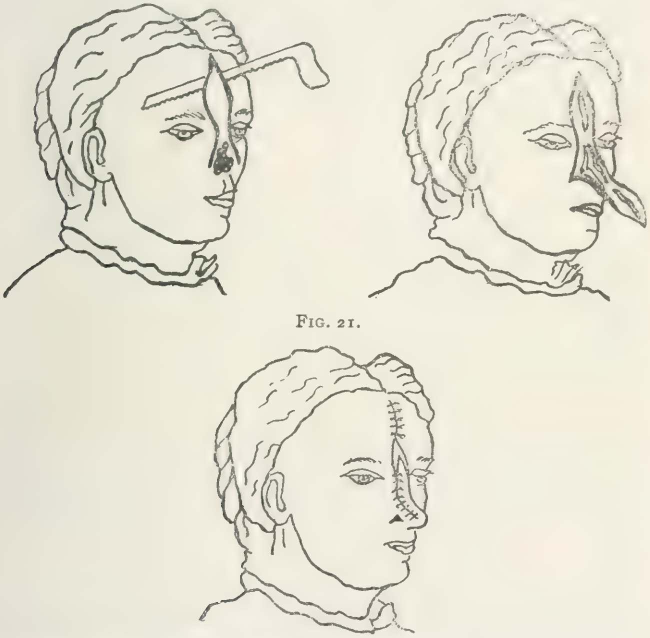


Rhinoplastic restoration of the alæ and lobule of the nose by a frontal flap. *a*, Before operation; *b*, Several ye
after operation. (Dr. Wm. G. Porter's case, from photographs.)

arm and subsequently applied to the nasal region, just as if it had originally been formed from brachial tissues. The retentive apparatus to hold the arm close to the face may be made from bandages and gypsum or from leather and webbing. The patient may be fitted with such appliances and wear them for a time prior to operation, in order to become inured to the discomfort due to their use. The brachial method is of more value probably, when partial rhinoplasty is to be done; because it scarcely ever can give sufficient rigidity to form an acceptable organ in total rhinoplasty.

Fig. 19. Fig. 20.

Fig. 21.



Charles Nélaton's method of osteoplastic rhinoplasty in partial loss of the external nose. (La Rhinoplastie, Nélaton and Ombrédanne.)

Schimmelbusch has devised a method in which he uses a large osteoplastic flap from the forehead and slides large areas of the scalp from the temporal regions to cover the denuded space. The bony flap is covered with Thiersch grafts and then reversed.

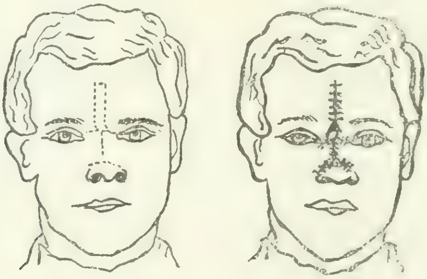
Some operators have employed both frontal and brachial flaps, superimposing one upon the other.

The method described by Cheyne and Burghard may be found valuable in some cases of saddle nose.

For the various deformities requiring partial rhinoplasties there are almost innumerable operative devices.

In subtotal loss of the organ Charles Nélaton has sawed a long A-shape flap from the forehead and nasal margins, containing a plate of bone from the frontal bone and edges of the nasal and superior maxillary bones. This osteoplastic A-shape flap is slipped downwards and bent into shape to make a nose in the nasal region.

FIG. 22. FIG. 23.



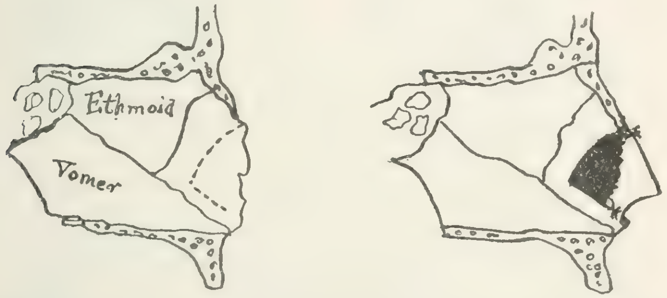
Restoration of the bridge of the nose by insertion of a strip of integument, periosteum and bone, from the middle frontal region, under the dorsal structures of the nose. (Cheyne and Burghard.)

Bardenheuer has devised a support for the anterior part of a new nose by incising the osteocartilaginous septum, if any remains, and turning forward a triangular flap, which projects beyond the plane of the face. On this support cellulocutaneous flaps are placed.

The so-called saddle nose, with its concave dorsum, elevated tip and nostrils presenting forwards instead of downwards, may need correction. It is apparently produced by an insufficient development of the nasal chambers and the nasal bones and cartilages. Moderate deformity of the kind is best corrected by injecting liquefied or soft paraffin, or paraffin and rubber under the skin with a syringe and hollow needle.

As the overlying structures on the bridge of the nose are often distensible, pieces of cartilage, celluloid or bone properly trimmed may be slipped under the skin, through a small incision, to fill up the hollow. The more pronounced instances may be remedied by splitting off pieces of bone at the lateral margins of the pyriform nasal opening in the skull, loosening them above, and pressing them towards the middle line. This raises the nasal bridge. They may be detached from their normal bony connections with small chisels introduced submucously or subcutaneously. The new raised position may be maintained till healing by transfixing the nose underneath them with a steel pin. Rubber pads or shot on the ends of the pin lessen the likelihood of displacement. Properly fitted external clamps may be used for a few days instead of pins.

FIG. 24. FIG. 25.



Bardenheuer's use of the anterior part of the cartilaginous and ethmoid septum as a support for the new nose made from the softer tissues. (Verhand. der Gesellschaft für Chirurgie, xxiv, i, 134.)

Noses in which depression of the bridge is great and especially those in which the skin is bound down, by old inflammatory adhesions, demand radical operative procedures. The sunken noses of syphilis with adhesions between the skin and the remains of the destroyed internal structures of the nose belong to this class. These distressingly ugly noses often have a sharply defined transverse groove across the middle of the sunken area; and the adherent integument is practically indistensible from cicatricial fibrous change. The term sunken nose is more applicable than saddle nose. In some of these cases the skin of the nose should be detached from the bones by an inverted U incision and a frontal flap turned down and tucked under it. A piece of cartilage or bone may be incorporated in or between these superimposed flaps. Occasionally the tissues may be satisfactorily raised by undermining the skin with a tenotome and injecting semi-solid paraffin.

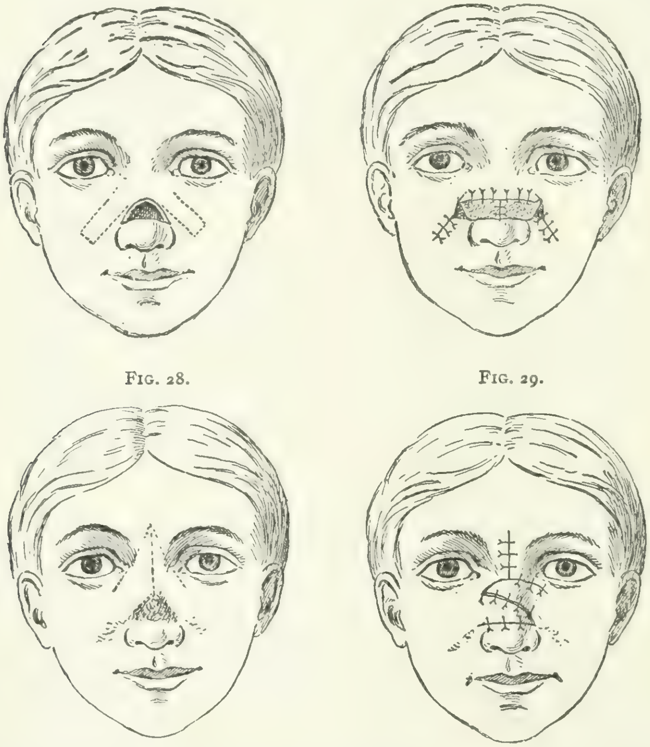


FIG. 26. FIG. 27.

FIG. 28. FIG. 29.

Roberts's method of operating upon the sunken nose of syphilis by superimposed flaps from cheek and nasofrontal regions.

The worst forms of syphilitic sunken nose require still more extensive operative reconstructions. The first step should be a deep cut across the sunken region in the transverse groove. This incision opens the nasal cavity and permits the lobule and alæ to be displaced downwards and forwards into the normal position. This manœuvre restores the prominence of the tip, or lobule, and makes the nostrils again lie in the horizontal plane. The next step is to fill the gaping opening

FIG. 30.

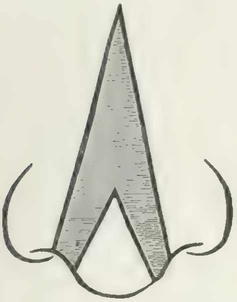


FIG. 31.

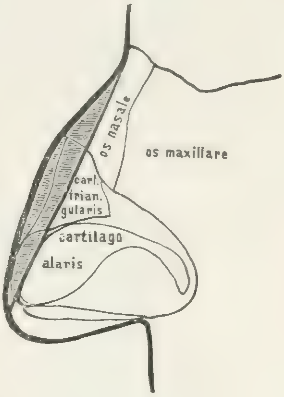
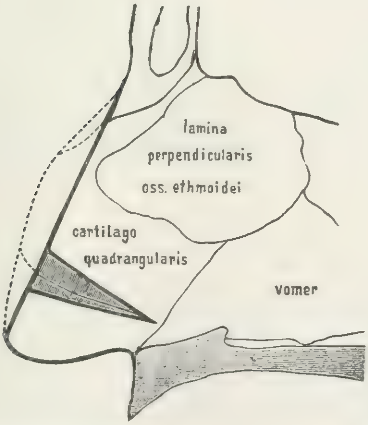


FIG. 32.



Jacques Joseph's method of diminishing the size of a giant nose. (Berliner klin. Wochensch., 1898, No. 40, and Deutsch. medizin. Wochensch., 1904, No. 30.)

between the lower margin of the bony bridge above and the replaced lobule and alæ below. The tissues used to close this large orifice must be permanently thick and rigid. Flaps may be taken from the forehead, or cheeks, or preferably from both.

I devised some years ago a method which answers well. The first stage consists in cutting a flap from each cheek near the naso-labial furrow. These are turned upward and inward to meet in the median line and thus cover in the opening. The skin surface is towards the nasal chamber. After these flaps have been united and cicatrized, the irregularities at their base are corrected by incisions and sutures. The next major procedure is to make an inverted V incision, from the middle of the forehead, the legs of which run downwards and outwards to points on the cheeks below the eyes. Just above the granulating surface on the former flaps, which closed the opening, a similar inverted V-shape cut is made. The apices of these two cuts are joined by a vertical incision in the middle line. This series of incisions marks out two rhomboidal flaps with their pedicles on the cheeks close to the sides of the nose. These flaps are then raised from the frontal and nasal bones and turned downwards over the cicatricial or granulating surface of the reversed cheek flaps, previously used to close the opening into the nasal chambers. The upper angle of the right flap is sutured to the base of the left alæ and that of the left flap is turned so as to reach across to a point near the inner canthus of the right eye. Sutures are employed to maintain the new relations of the frontonasal flaps, which have been laid upon the overturned cheek flaps; and the wound on

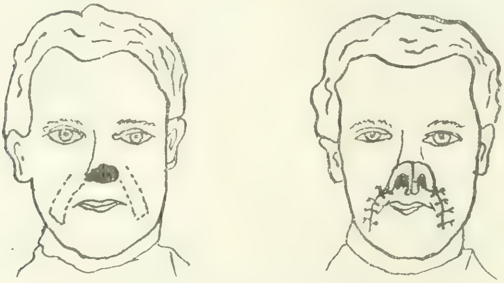


Fig. 36. Fig. 37.

Lobule, columella and alæ formed from flaps cut from lower part of the cheeks. At a later operation the base of the flaps are cut and the alæ are set nearer the columella to make proper nostrils. Bayer-Payr's method. (Deutsch. Zeitsch. für Chirurgie, Bd. lx 1901, 142.)

FIG. 33.

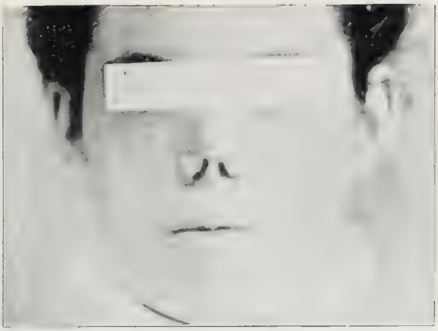


FIG. 34.

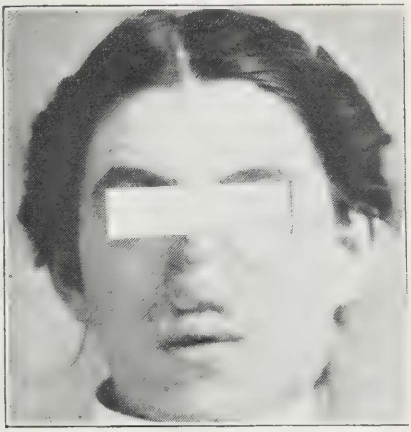
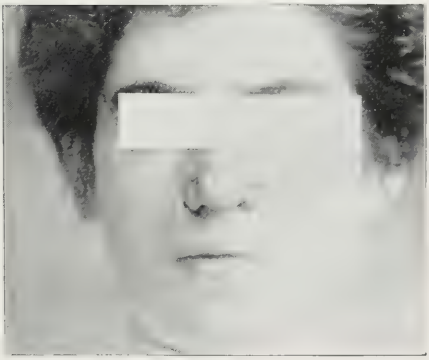
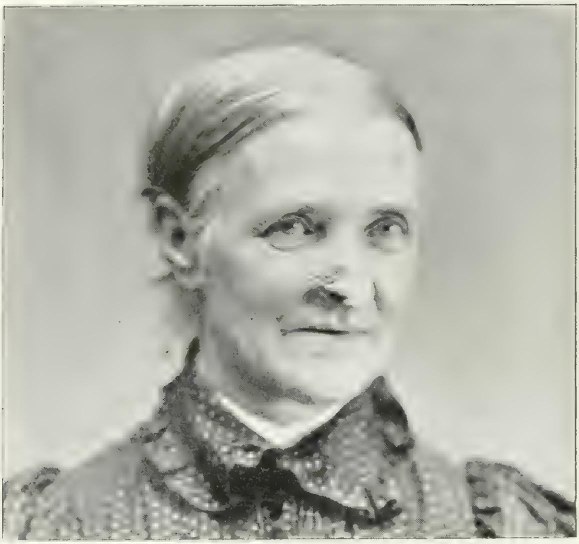


FIG. 35.



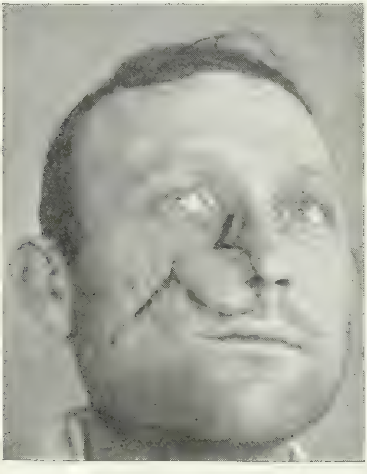
FIGS. 33, 34, AND 35.—Photographs of a case of restoration of the end of the nose by flaps taken from the cheeks. (Roberts.)

FIG. 38.



Ala repaired by attaching the finger tip to the nose and later cutting the finger loose. Dr. J. P. Tunis. (Roberts's Deformities of the Face.)

FIG. 39.



Ala made by flap from cheek. Secondary modelling operations were performed later. (Roberts's Deformities of the Face.)

the forehead is easily closed in a vertical direction. The scars are inconspicuous, and much rigidity is given to the tissue interpolated between the root of the nose and its lobule. The internal surface of the interpolation is lined with skin and so is the external.

A very large nose may be successfully reduced in size by an operation devised by Jacques K. Joseph. His operation consists of three procedures, which are done at one sitting. The great width of the organ and the large nostrils are diminished by excision of an A-shape portion of integuments and cartilage on the anterolateral surface of the nose. Then the bony and cartilaginous roof is pared away with chisel and scalpel to reduce the prominence of the organ. Finally the nasal septum is shortened by cutting out a wedge with its

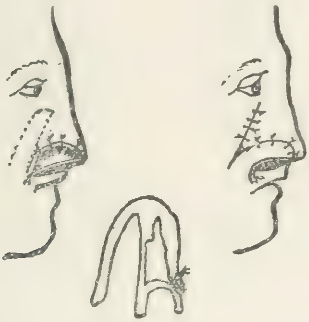


FIG. 40. FIG. 41.

FIG. 42.

Henry Thompson. (Dublin Hospital Gazette, August 15, 1855, p. 212.)

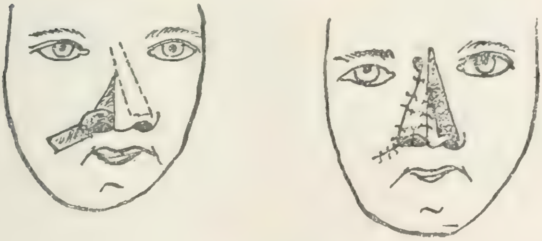


FIG. 43. FIG. 44.

Operation for restoring ala of nose. (von Hacker, Beiträge zur klin. Chirurgie, 1897, xviii, p. 545.)

base forward and its point directed downwards and backwards. Careful suturing of these wounds converts a gigantic nose into a much smaller organ. Joseph's report says that his patient was much improved and greatly pleased with the change.

Fig. 45.

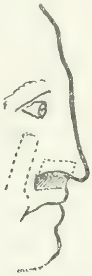
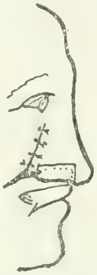
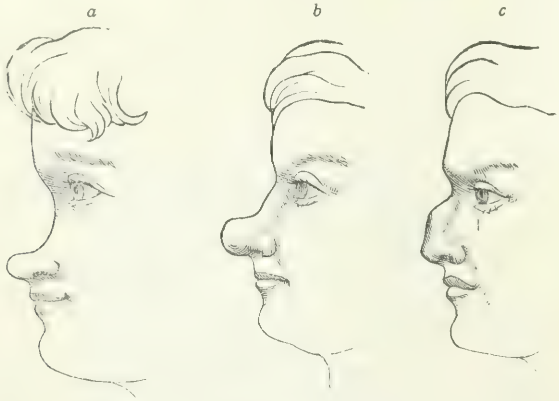


Fig. 46.



Jalaguier's method of treating cicatricial closure of nostril. A flap from upper lip is turned into nostril and stitched to inner wall of ala; then a flap from cheek is used to cover raw surfaces on septum, floor of nostril and upper lip. (Bull. Soc. de Chirurgie de Paris, 1902, p. 892.)

Fig. 47.

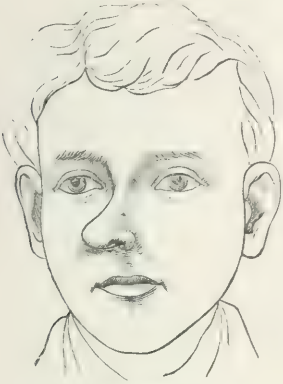


a, saddle nose; *b*. tuberous nose; *c*, angular nose. (From Roberts's Crooked and Otherwise Deformed Noses.)

For restoring the alæ or the lobule of the nose, lost by frost-bite, cauterization or excision, flaps may be taken from the cheeks, the lips or even the chin. In some instances pedunculated flaps from the arm or hand may be utilized, if the constrained posture of this procedure is not deemed undesirable.

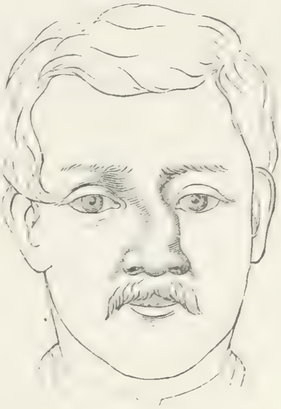
The Bayer-Payr method cuts flaps from the sides of the chin and turns them up to make alæ and columella. The new alæ may be lined with mucous membrane dissected from the nasal septum or repaired with a flap from the cheek with the skin surface turned inwards. Thiersch grafts or small skin flaps thrust through buttonholes in the skin may give aid in this endeavor. The alæ needs to be stiff enough not to collapse during inspiration. A slip of cartilage taken from the ear may be inserted, or scales of cartilage cut from the costal cartilages may be employed.

Fig. 48.



Bent nose.

Fig. 49.



Twisted nose.

Fig. 50.

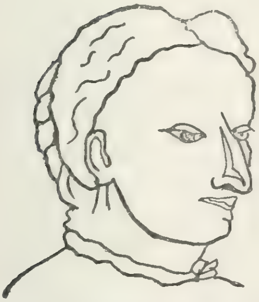
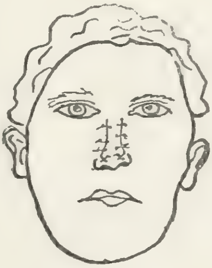


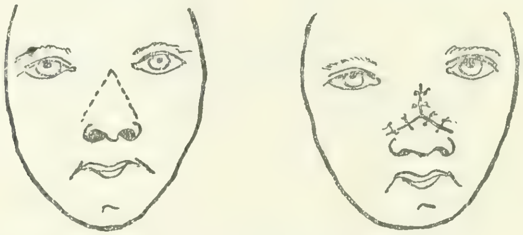
Fig. 51.



To lessen size of nose when soft parts are too bulky, as after plastic restoration. When bones and cartilages are gigantic the methods of Dr. Jacques Joseph are to be used.

I have stiffened the columella of a soft nose by inserting a peg of cartilage cut from the tip of the eighth left costal cartilage. This gave the lobule the proper projection forwards. The columella may be made from two vertical flaps cut from the upper lip, one on each side of the median line, involving only a part of the thickness of the lip. The entire thickness of the upper lip may be similarly employed for a single median flap. Longitudinal labial flaps may be chosen, or the tissues between the thumb and forefinger may be grafted into the gap, by applying the hand to the chin for about two weeks. A portion of the nasal spine of the upper jaw may be chiseled loose and reflected upwards to give rigidity to the new columella, which is to be constructed.

FIG. 52. FIG. 53.



Dieffenbach's method of making a short nose longer and wider and restoring the nostrils to the horizontal plane.

Atresia of the nostrils may be overcome by appropriate use of cutaneous and mucous flaps. Bent and twisted noses of various forms may be corrected by dividing the bones and cartilages thoroughly with saws and knives after loosening the soft parts subcutaneously with a tenotome. The deformity should then be overcorrected by removing interfering cartilage and bone. The new relations of the nasal structures must then be maintained for about ten days by means of pins or intranasal splints. Flat noses, short noses and large noses may be successfully modified.

Noses the seat of rhinoscleroma may be restored to a much more shapely condition by simply shaving off the excess of hypertrophic tissue.

RHINOPLASTY BY MEANS OF ONE OF THE FINGERS.

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OF CHARLOTTESVILLE, VA.,

Professor of Surgery in the University of Virginia; Surgeon-in-Chief to the University of Virginia Hospital.

O. G., aged 24, farmer, was admitted to the University of Virginia Hospital on December 24, 1907, with the history of having been injured a few hours previously by the accidental discharge of a shotgun at close range. The load passed across the front of the face, tore away a portion of the left cheek, the anterior wall of the left antrum of Highmore and the greater portion of the nose, producing a ghastly wound (Figs. 1 and 2). The wound was somewhat triangular in shape, the apex of the triangle being at the outer margin of the left malar prominence, the base extending from the right internal angular process to within 1 cm. of the root of the right nostril. The left ala nasi was completely severed. The structures involved were the soft structures of the left cheek, the anterior wall of the antrum of Highmore—into which an opening 1 cm. in diameter was made—the soft structures of the nose from the glabella to within 1 cm. of the tip of the nose, the nasal bones, the cartilaginous and bony septum of the nose and the anterior quarter of the left inferior turbinate bone.

The wound was comparatively clean and granulated rapidly. It was proposed to him to restore the bridge of the nose by using one of the fingers, and then to cover in the openings upon either side of the finger by means of a flap from the arm in the manner that the canvas is stretched over the ridge pole of a tent. He readily consented.

January 15, 1908, the operation was begun. After dissecting up the columna of the nose and denuding the distal phalanx of the little finger of the left hand, the nail being removed and the matrix thoroughly destroyed to prevent further growth of the nail, the finger was inserted through the remnants of the nose and fixed to the skull with silver wire (Fig. 3). The arm was held in place by means of a plaster cast.

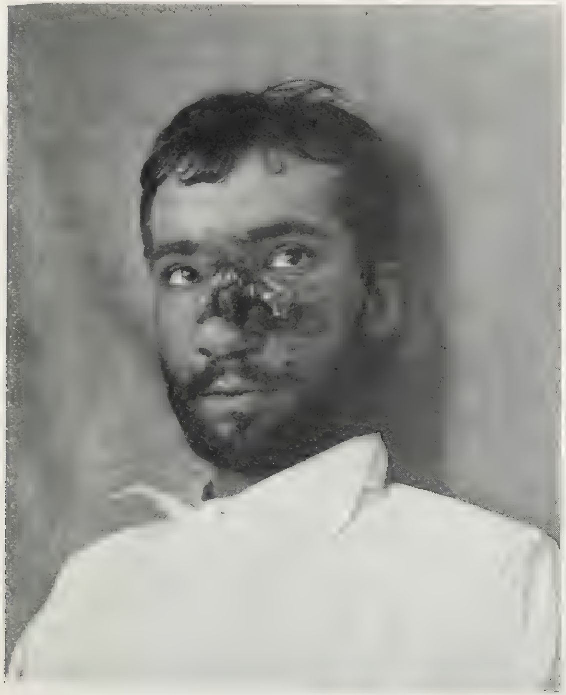
February 1, the finger was amputated under local anæsthesia (Fig. 4) and a few days later the end of the finger was trimmed off and the bone of the proximal phalanx removed in order to diminish the thickness of the septum and restore the size of the nostrils. The columna was then sutured in place over the end of the finger (Fig. 5).

February 14 the skin on the dorsum of the finger was removed and after dissecting up a flap from the right forearm this flap was sutured to the right margin of the nasal wound, the arm being again immobilized in a plaster cast (Fig. 6).

February 28 the flap was severed from the arm and its free edge sutured to the left margin of the nasal wound, covering the opening to the left of the finger.

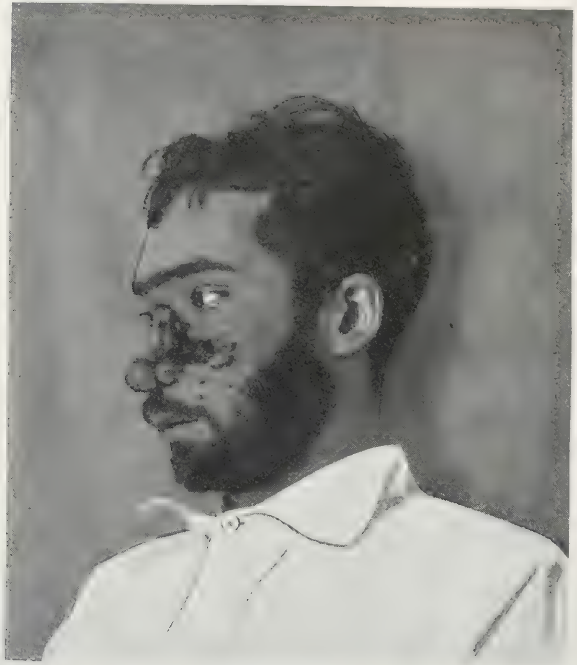
An excellent cosmetic (Fig. 7) and functional result was thus obtained.

FIG. 1.



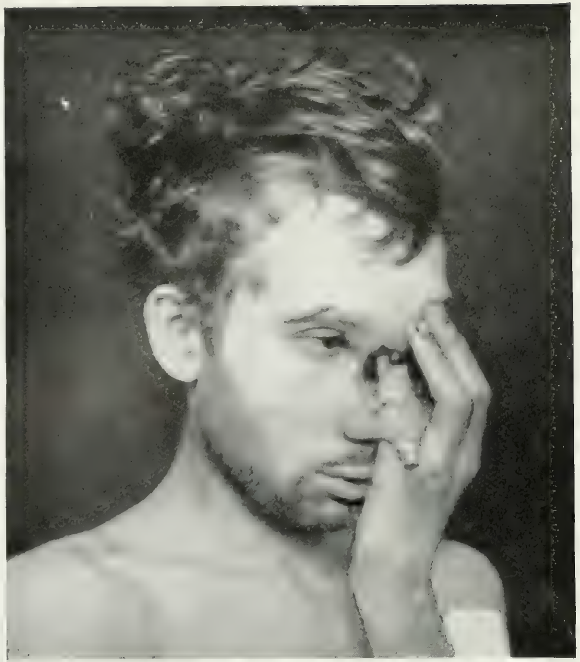
Full view, showing destruction of bridge of nose.

FIG. 2.



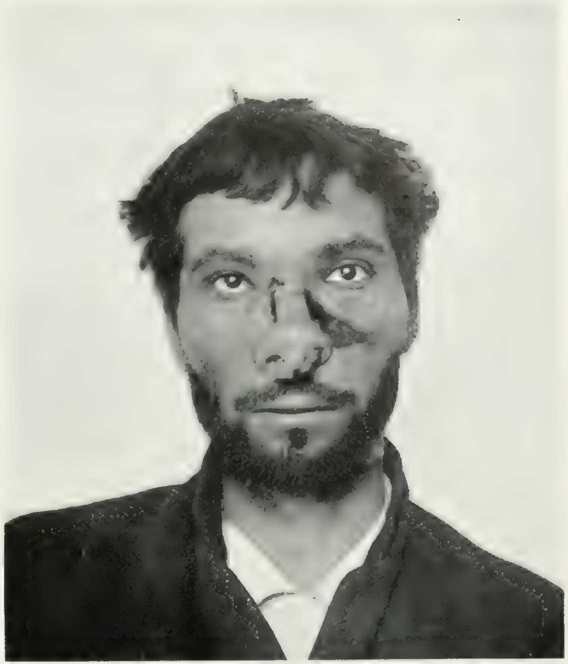
Profile view.

FIG. 3.



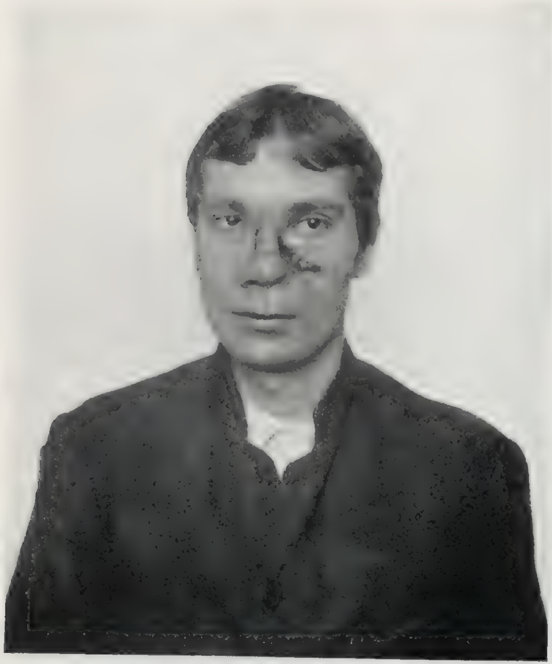
Finger in position, wired to skull.

FIG. 4.



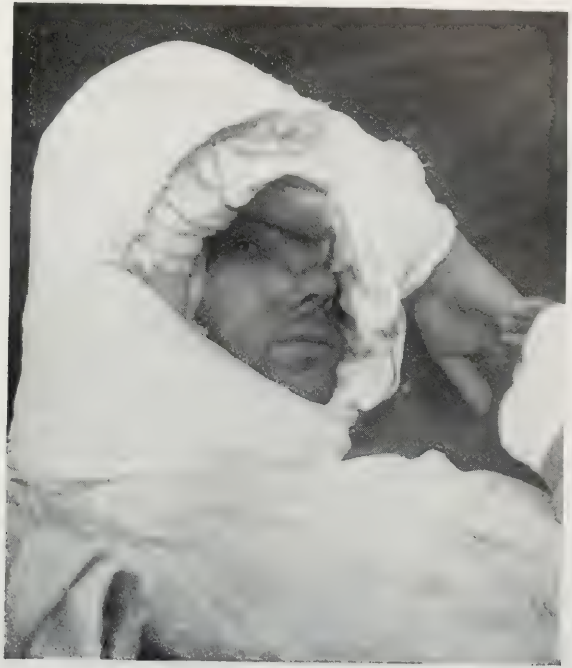
Finger severed from hand.

Fig. 5.



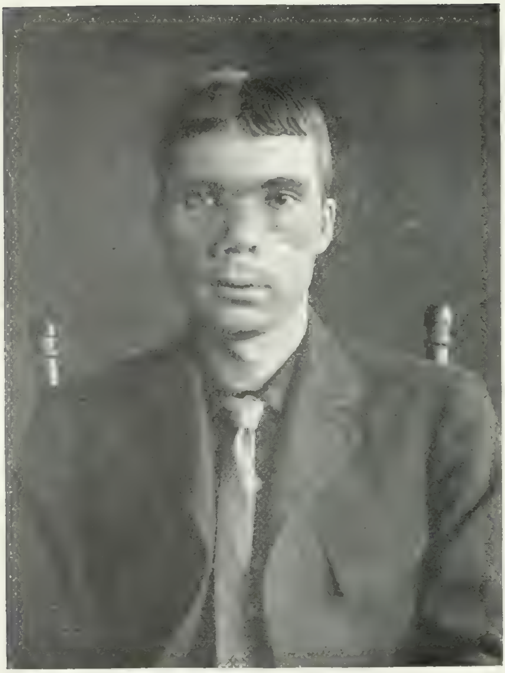
Finger trimmed up and septum sutured in place.

Fig. 6.



Covering finger with flap from arm.

Fig. 7.



Final result.

TRAUMATIC LESIONS OF THE ATLAS AND AXIS.

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AND

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There exists much lack of knowledge concerning the subject of non-fatal injuries to the upper two cervical vertebræ. The matter was first called to our attention by the observation of a rather remarkable case and the interest thus aroused has led to the discovery of others and to a review of the literature. By considering the production of the injury and by describing the immediate and subsequent symptoms we hope to make their diagnosis more easy and their rational treatment and intelligent prognosis more clear.

Literature.—At least three important articles on the subject of injuries to the upper cervical vertebræ have appeared in recent years. The first is by Walton, in the *Boston Medical and Surgical Journal* in 1903, on "Cervical Dislocations and Their Reduction"; the second by Corner in the Annals of Surgery in 1907, on "Rotary Dislocations of the Atlas," and the third by Van Assen in the twenty-first volume of the "Zeitschrift für orthopädische Chirurgie."

Walton's article is the first clear description which we have found of the cervical dislocations and the rational method of their reduction. He believes them to be far commoner than has been supposed. They are usually unilateral and consist of a rotary displacement, the upper vertebræ on the side of the lesion slipping forward and either catching on the apex of the articular process below or slipping over it into the intervertebral notch. These lesions are non-fatal, do not cause symptoms of compression of the cord, and are capable of reduction after long periods by proper manipulation.

Corner's article on "Rotary Dislocation of the Atlas" is comprehensive and attempts to cover the reported cases of fatal and non-fatal injuries to the atlas and axis. He calls attention to the fact that in order to allow the free motions of the head the ligaments are all lax, that the head therefore must be held firm by muscular action alone,—and that if for any reason this muscular support is lacking, any blow has, to use his words, a "flying start" in the production of the dislocation or its complicating fracture. From his cases it is evident that the most important point to determine as well as often the most difficult is the fracture or integrity of the odontoid process. In 6 of the 8 fatal cases of Corner the odontoid was broken. In the 10 non-fatal cases only once. It also is suggestive to realize that of his 8 fatal cases in only 2 did death or paralytic symptoms follow soon after the injury, periods varying from twenty-three days to several years elapsing in all the others, and that the cause of death at this time was either injudicious movements made by the patient or his physician or the development of a myelitis.

The last article which we shall review is one by Van Assen, from Joachimsthal's clinic, and primarily the report of a case of fracture of the posterior arch of the atlas and of the odontoid process with a probable accompanying rotary dislocation of the atlas on the axis. It is more than this, however, for he too attempts a review of the literature and brings out certain important facts. He reports a collection of 136 cases of spinal injury made by Wagner and Stolper, who found among these only 1 of injury to the atlas and axis. Out of 19 cases of injury to the atlas collected by Van Assen only 1 was diagnosed in the living and many of them were associated with lesions of other vertebræ. He states that only 6 authentic cases have been recorded of isolated fracture of the atlas. In the 12 reported cases of fracture of the axis 9 times the odontoid only was broken. It is seen, therefore, that reports of injury to the atlas alone are very rare, and that injuries to the axis alone or in conjunction with the atlas are not often recognized in the living.

Production of the Injury.—In general these lesions result from violence of some sort. Falls from a height or down stairs are commonest causes. In these cases the blow is received on the fore part of the head and from above downwards. In Dr. Wilson's case, reported in the ANNALS OF SURGERY, April, 1907, there is reason to believe that at least the final displacement was accomplished by an osteopath, who exerted in one of his manipulations quick forcible pressure on the top of the subject's head while he was standing. The patient immediately fell to the floor, but afterwards recovered.

In a case reported by Lambotte, a sudden movement of the head was made by a young woman while sewing. Stiffness of the neck and pain in the head followed, but not until a year later did paralytic symptoms ensue. The postmortem showed the odontoid to be fractured across its base transversely and repaired by some fibrous tissue. There was a rotary dislocation of the atlas on the right. The transverse and check ligaments were intact.

The case resembles in many ways one which has been described by Dr. F. H. Albee ("Case Teaching in Orthopedic Surgery," Case VII) (see Case IV, end of article) in which the symptoms followed a jerk of the head secondary to a sudden push of the body.

It is evident then that while violence is the common cause of dislocation and fracture of the upper two cervical vertebræ we must recognize that severe lesions may occur from surprisingly slight traumatisms,—indeed, if we accept Lambotte's case, from muscular action alone.

The More Common Types of Lesion.—We have outlined above the commonest lesion of all, as pointed out by Walton, namely, a unilateral subluxation or true dislocation unassociated with fracture. The rotary dislocation of the atlas on the axis as described by Corner belongs in this class and is illustrated by the outline drawing in Fig. 1.

The next most common type is the fracture of the odontoid, usually accompanied by rotary dislocations. Skiagraphs of this lesion when compared with the normal lateral skiagraph (Fig. 2) demonstrate very clearly this lesion (*cf.* Figs. 3, 7, and 10). Four of the cases referred to in this article where this displacement has occurred are still living and have had no symptoms of cord compression. This fact is certainly interesting and to the writers has been surprising.

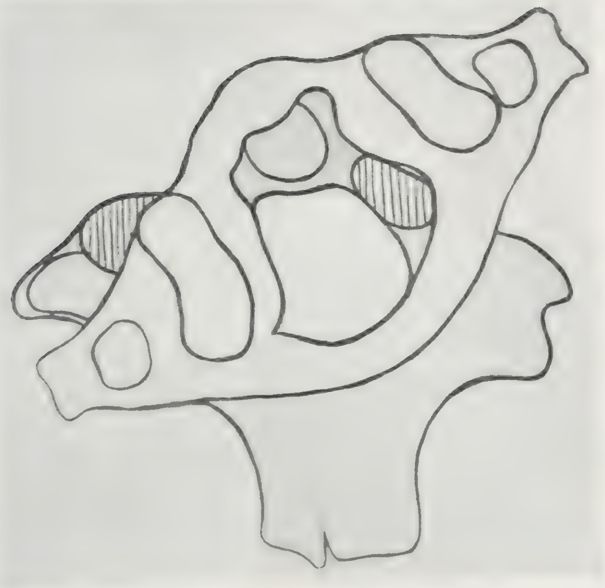
The third and far less common forms of lesion are those in which the arches or lateral masses of atlas or axis have been fractured with or without accompanying dislocations and fractures of the odontoid. Two of the cases which have been observed by the writers illustrate this type (Case II; see page 202. Case VII; see page 205), as does also Van Assen's case (Case III; see page 202).

Immediate Symptoms.—The immediate symptoms which follow these injuries vary from almost instant death to an almost entire absence of all symptoms except neck rigidity and asymmetrical head position. The striking phenomenon is the frequency with which only comparatively slight symptoms result. Severe occipital neuralgias and neck rigidity with increase of pain on any attempted active or passive movement of the head are nearly always present and should lead one to suspect bony lesion.

Subsequent Symptoms.—The rigidity and as a rule the occipital neuralgia persist. Sudden movements or attempts at reduction are often followed by immediately fatal consequences, but the most important end result as shown by many cases reported by Corner has been the gradual onset of a myelitis apparently caused by the irritation of the long-continued abnormal position, or in case of fractures by callus formation (*cf.* Case VI).

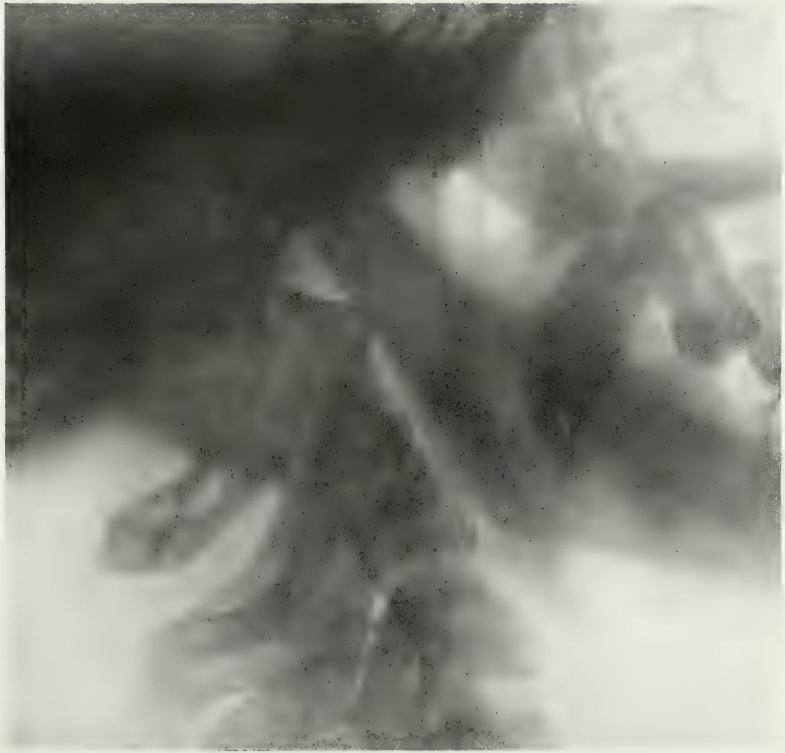
Diagnosis.—We need hardly emphasize the importance of the X-ray in making the diagnosis. Lateral X-rays of the neck represent no special technical difficulties, and show well

FIG. 1.



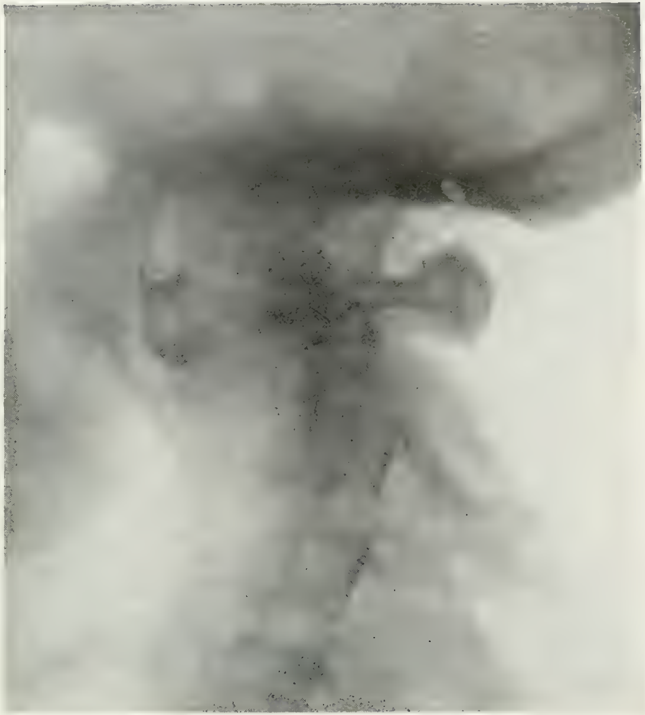
Diagrammatic representation of rotary dislocation of the atlas—and occiput—on the axis. (Corner.)

Fig. 2.



Lateral skiagraph of normal cervical spine.

Fig. 3.



Lateral skiagraph of Case I. *Cf.* Fig. 2 and note different relations of atlas and axis.

any anteroposterior abnormality and often suggest a lateral asymmetry in a dislocation (*cf.* Fig. 8) (Case V, page 204). The ordinary anteroposterior X-ray of the neck is valueless as far as the atlas and axis are concerned, the mental prominence and teeth entirely obscuring any clear view. If the patient can open his mouth, however, most important information may be had by a skiagraph taken through this wide open aperture (*cf.* Fig. 9) (Case V, see page 204). Odontoid fractures may be seen and any lateral displacement demonstrated.

When good X-rays are not available much may be determined by inspection and palpation. Inspection reveals the probable displacement if one reasons out the lesion necessary to produce the individual asymmetry. By palpation one may discover many things. The line of the spinous processes and their relative anteroposterior position should be first determined. If the spine of the axis is abnormally prominent a fracture of the odontoid is to be suspected. Normally the transverse process of the atlas can be felt half way between the tip of the mastoid process and the angle of the jaw. The location of these processes is, therefore, significant and must be studied. The value of the examination of the pharynx by palpation, preferably under anæsthesia, can hardly be overestimated.

As Corner has originally pointed out, in the rotary dislocations of the atlas two abnormal prominences may be made out, one due to the forwardly displaced transverse process and lateral mass of the atlas on the side of the marked dislocation and the other on the opposite side and a little lower, corresponding to that portion of the axis which is made more evident by the slipping backwards of the atlas.

In spite of the helpfulness of all these signs it is difficult to determine positively the integrity of the odontoid. The importance of this determination is, however, made apparent by several cases in which the penalty for what proved unintelligent manipulation has been the life of the patient.

Treatment.—If one can convince himself that a simple unilateral rotary dislocation of the atlas or axis has occurred intelligent manipulation offers every hope of cure. Dr. E. W. Ryerson of Chicago and one of the writers have even reduced cases of six months' standing. Walton has called attention to the fact that extension alone, or accompanied by rotation, is an inefficient and somewhat dangerous procedure. If one considers the anatomy of the lesion it is evident that his method is the only rational one.

This consists of first freeing the dislocated articular facet of the upper vertebræ from its position. Whether this upper articular process has simply caught on the apex of the process of the vertebræ below or actually slipped forward into the anterior notch is a difference only of degree. It should be first lifted free and then rotated into place by the manipulation of dorsi lateral flexion followed by rotation. For example, if the left inferior articular process of the axis has slipped forward and we suppose the patient to be facing North, we should first bend the head without traction to the East and South, *i.e.*, to the right and backward, possibly rotating a trifle in the direction of the deformity to better free the process. We should then rotate toward the West and North, *i.e.*, turning the head to the left and bending it forward. This uses the undislocated joint as a powerful fulcrum which is lost if traction be employed as well. It is helpful to remember that the chin will point to the side opposite the main lesion. In a doubtful case where the exact nature of the lesion is not clear and where we may be dealing with a fractured odontoid, we advise support and fixation by means of apparatus such as the Thomas collar, or a plaster helmet, until a definite diagnosis can be made. Corner believes that in cases where the odontoid seems probably to have been broken that the patient should be kept in bed with the head immobilized for at least three weeks; that then an anæsthetic should be given, and with an examining finger in the pharynx an attempt at reduction should be made.

None of the authors consider operative procedures possible. The writers, in conclusion, wish to report an unusual case, with as far as is known an original operation. In light of the apparent frequency of odontoid fractures which are not immediately fatal and the common subsequent occurrence of myelitis, from the irritation caused by the abnormal mobility it seems possible that this operative procedure may have a wider range of usefulness than we had anticipated.

Case I.—R. M., age 15, was sent to one of us in July, 1906, by Dr. Maurice H. Richardson for an opinion as to cervical dislocation.

In brief, the history is that five weeks previous he had fallen from a tree, striking his head against a limb on the way to the ground. Immediate pain and stiffness of the neck followed with the appearance of a swelling on the left side high up. The condition had not materially changed since the accident. There had been no paralytic symptoms, though there had been acute paroxysms of pain during which the boy asked to be killed. The pain radiated over the head and down the shoulder and arm.

Examination showed a thin, sick-looking boy, with a tender prominence on the left side of the neck corresponding to a forwardly displaced transverse process of the atlas. This prominence could be felt on the posterior wall of the pharynx. Several X-rays taken at this time and soon after revealed no lesion which could be accurately interpreted.

All motions of the head were restricted and painful. The chin pointed to the right. The left tonsil was enlarged. The temperature was 100° F. Further general examination was negative.

A rotary dislocation of the atlas or possibly the axis was supposed. The boy was sent to the Massachusetts General Hospital, and under an anæsthetic the head was gently manipulated by Dr. Richardson, with an apparent return to normal conditions and almost complete flexibility. This condition remained for a few days. The boy was taken home against advice, but old conditions returned very soon. Six months after the accident the boy was again seen, and as conditions were almost intolerable on account of the severe occipital neuralgia, he was again sent to the hospital and a second manipulation was performed by one of the writers. The same flexibility and apparent reduction were present after this manipulation. More X-rays failed to suggest the real lesion, and in a complete plaster helmet the symptoms were relieved for one month. The helmet was then removed and a high Thomas collar applied. In a week the symptoms had recurred with added severity and at this examination the spines of the axis and third cervical vertebræ were evidently much more prominent than before. A fracture of the odontoid was for the first time suspected and confirmed by X-rays taken laterally (Fig. 3) and through the mouth.

The symptoms were evidently caused by the slipping forward of the atlas. The odontoid evidently showed no tendency to unite. The boy reentered the hospital on Dr. Mixter's service and was put to bed with head extension. A leather cuirass in two pieces (Fig. 4) was made from an accurate cast taken by laying the patient in a bed of soft plaster and then making the anterior half by pouring over the chest and neck thin plaster cream.

When this accurately fitting apparatus was ready the following operation was performed. The boy was placed in the ventral position, the head being supported manually over the end of the table. A linear four-inch incision was made in the median line of the neck and carried down until the hooked spine of the axis was defined. Next the posterior arch of the atlas forwardly displaced was sought and exposed. With an aneurism needle a stout braided silk soaked in compound tincture of benzoin was passed about this posterior arch between it and the spinal cord. While forward pressure on the anterior arch was exerted through the pharynx, traction was made on the posterior arch. There was firm resistance to replacement and only a slight amount of reposition was accomplished. This was maintained, however, and the atlas firmly anchored by tying the silk band about the hooked spinous process of the axis. The wound was closed with deep silkworm gut sutures, and the leather cuirass applied and strapped tight (Fig. 4, *a* and *b*). The wound was dressed through a posterior window. There was first intention and the boy made an uneventful convalescence, with no paralytic symptoms and an absence of pain. The apparatus was worn for two months, gradually omitted, and up to the present time he has remained well, without symptoms other than slight stiffness of the neck, and has led an active life.

It is now somewhat over two years since the operation and his present appearance is seen in Fig. 5.

Fig. 4a.

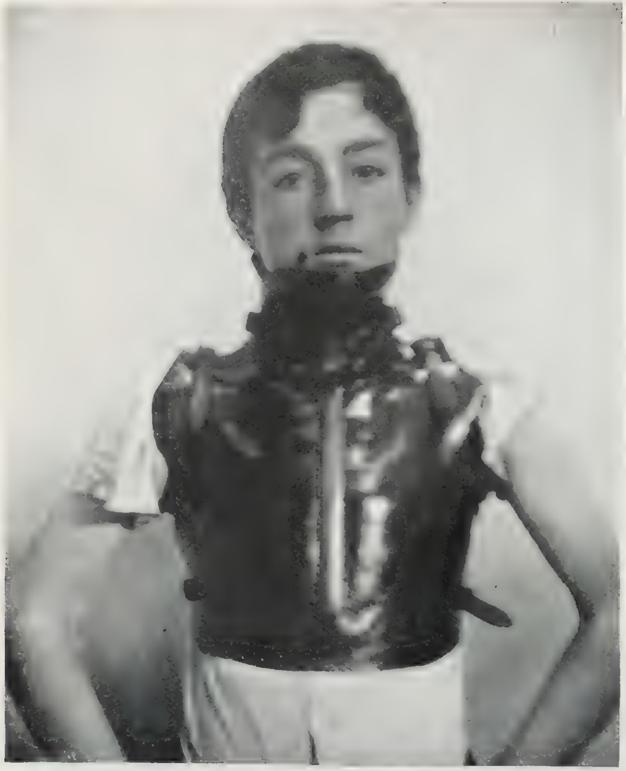
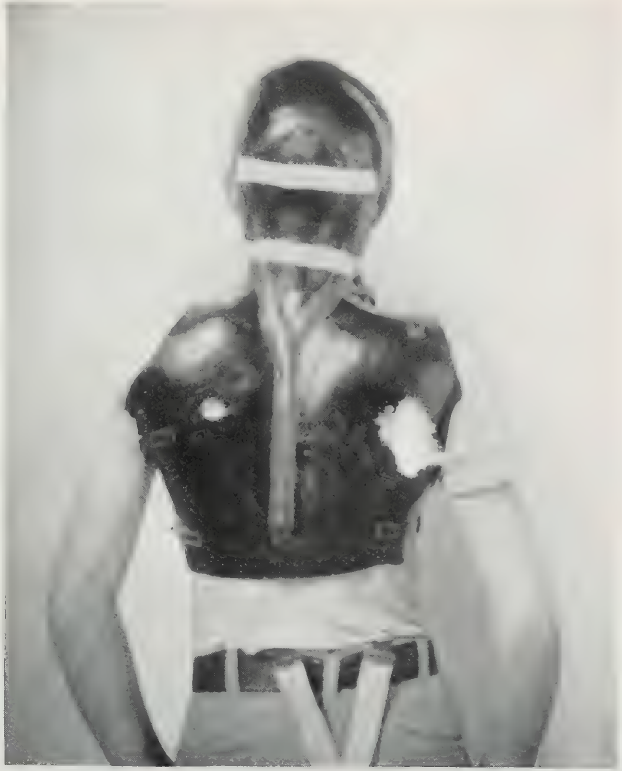
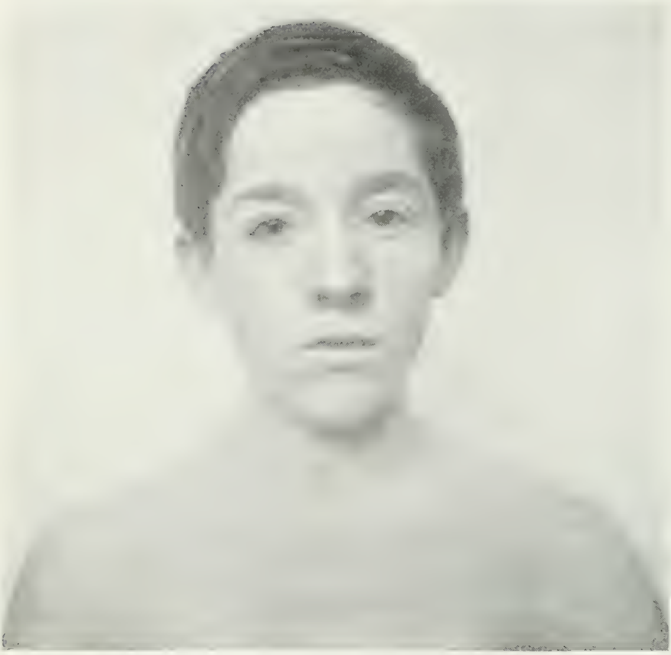


Fig. 4b.



Case I. in apparatus applied immediately after operation.

Fig. 5.



Case I.—Present appearance.

Fig. 6a.

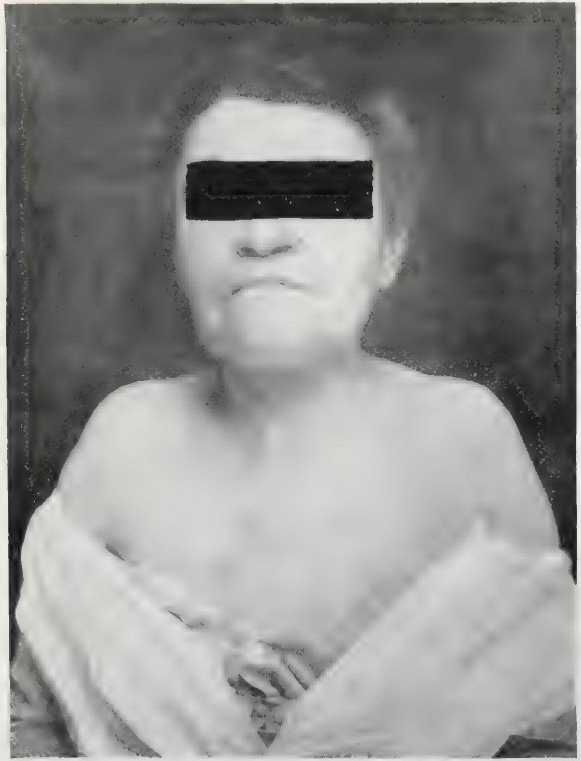
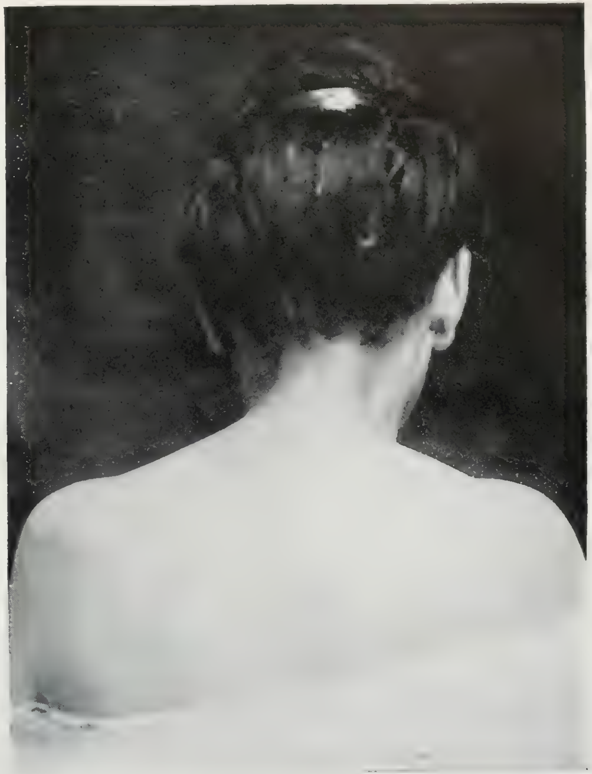
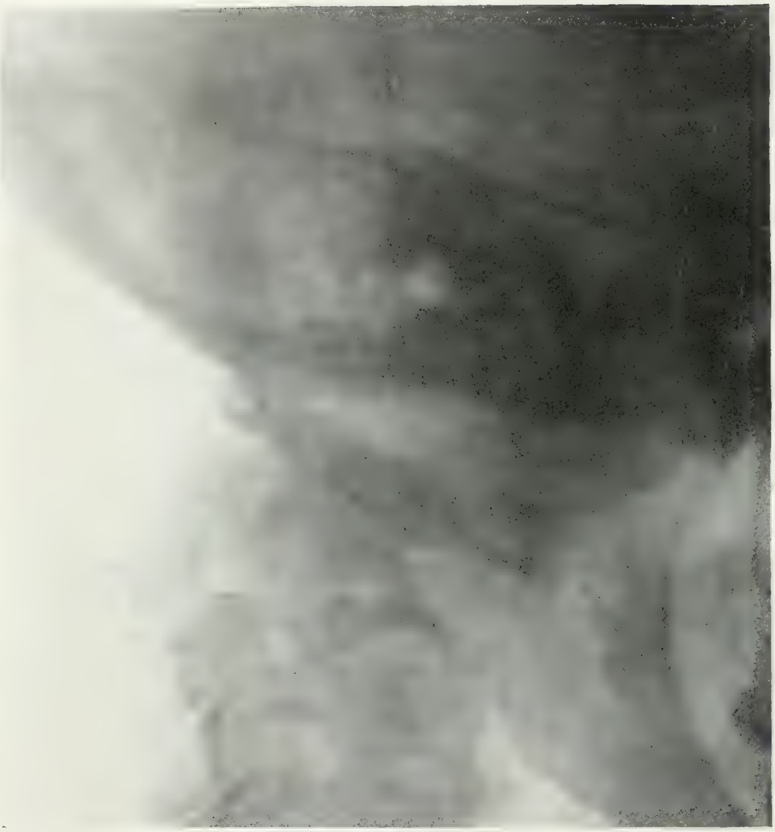


Fig. 6b.



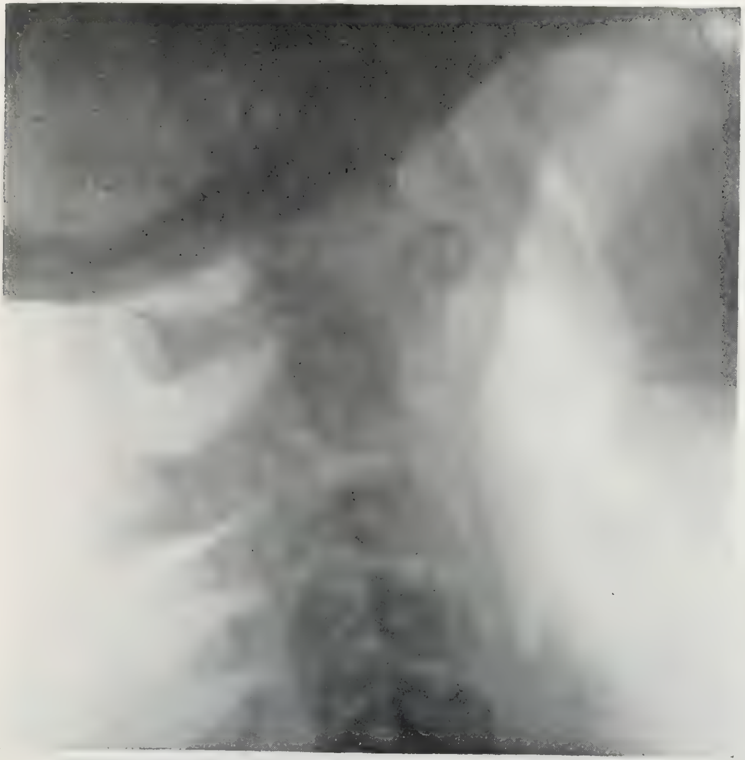
Case II.—Rotary dislocation of atlas on axis. Probable fracture of the anterior arch of the atlas.

FIG. 7.



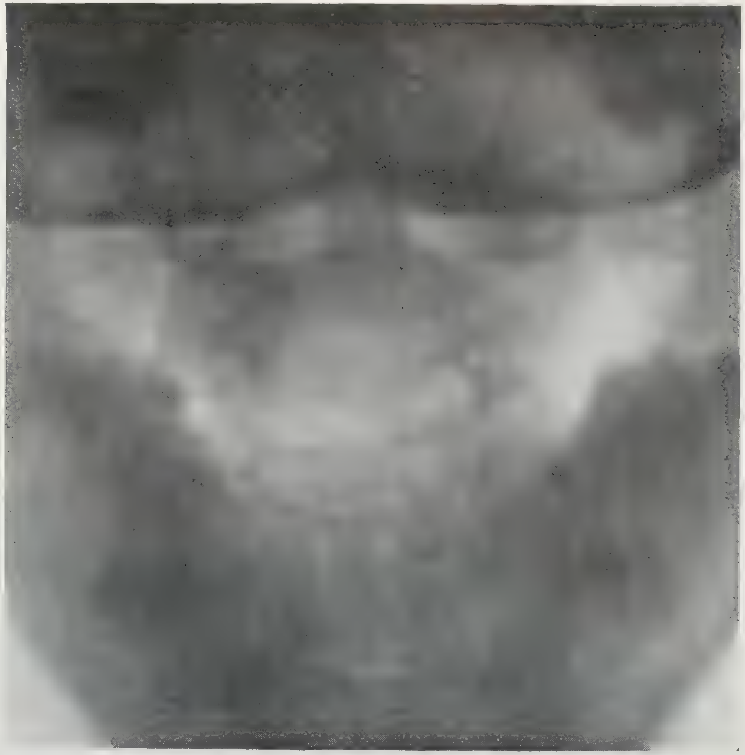
Probable disease of the atlo-axoid joint, with marked forward displacement of the atlas. No symptoms of cord compression.

Fig. 8.



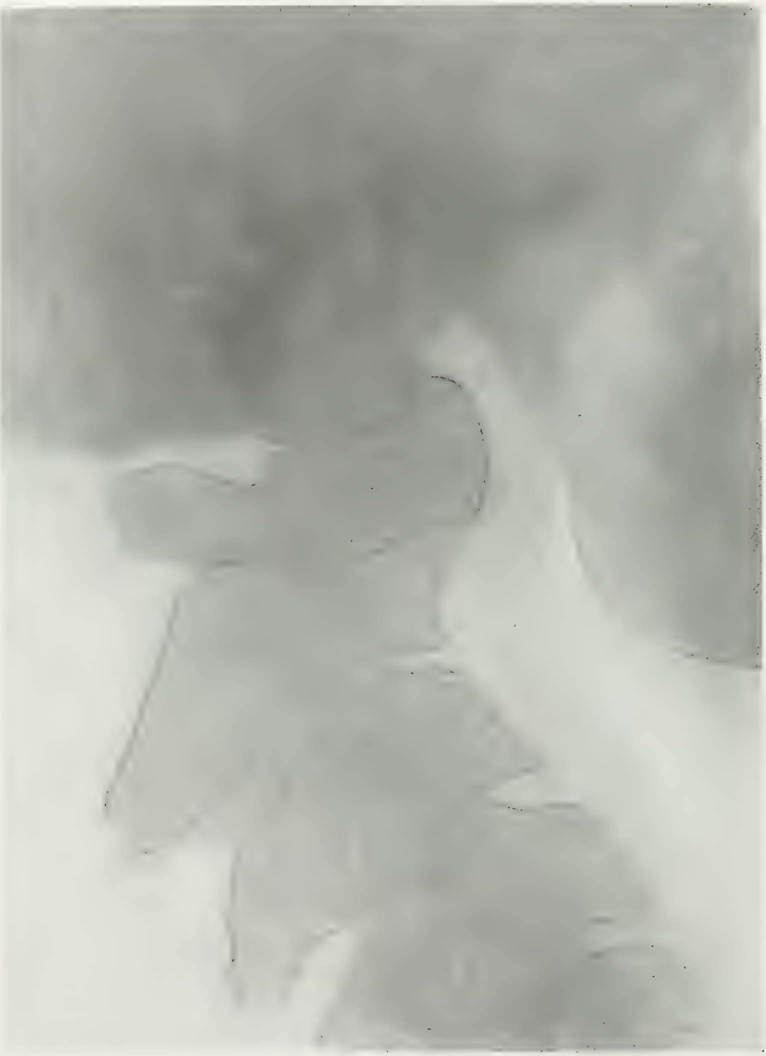
Lateral skiagraph of Case V. Note the apparent slight forward displacement of the atlas, due to the rotary dislocation. (Skiagraph by Dr. G. S. Johnston, of Pittsburg.

Fig. 9.



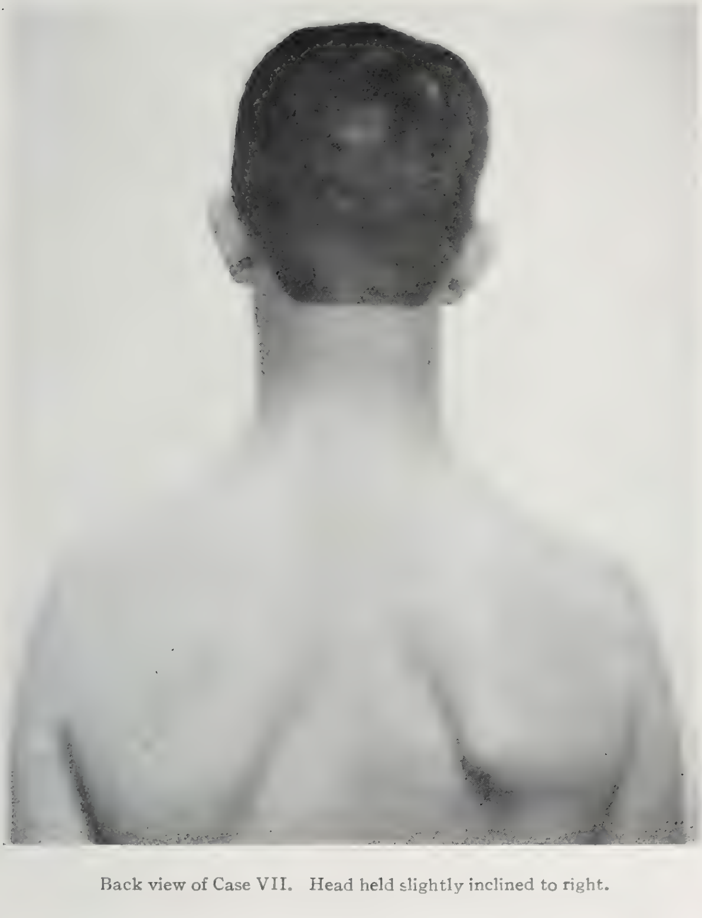
Anteroposterior skiagraph of Case V. Note the clear view of the unbroken odontoid process and the asymmetry of the two alto-axoid joints (rotary dislocation of the atlas). (Skiagraph by Dr. G. S. Johnston, of Pittsburg.)

Fig. 10.



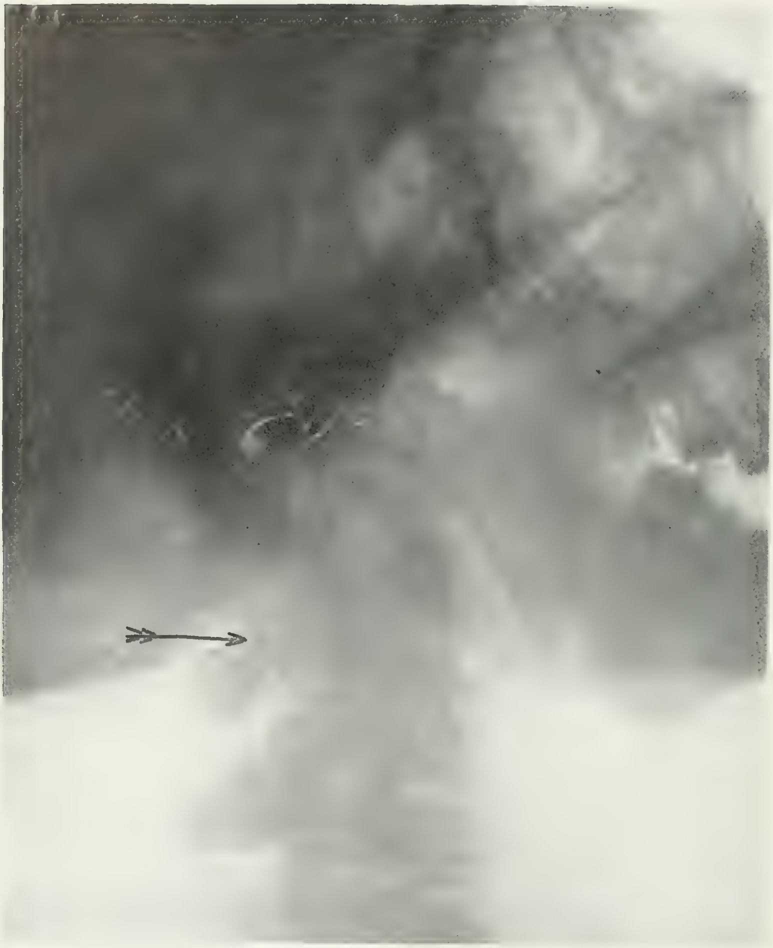
Lateral outlined skiagraph of Case VII, showing marked forward displacement of the atlas.

FIG. 11.



Back view of Case VII. Head held slightly inclined to right.

Fig. 12.



Lateral skiagraph of upper cervical spine of Case VII. Arrow points to fracture of posterior arch of atlas, shown well in the negative but indistinct in the reproduction, appearing like an exostosis.

Case II.—C. F., age 58; female (Fig. 6, *a* and *b*). Ten weeks before being seen, while groping about during the night to find the bathroom, she became confused and fell down a flight of thirteen stairs, striking head and neck and shoulders. She felt a distinct "crack" in the neck, referred to just below occiput. Not unconscious, she was picked up, but could not open mouth well; immediate pain referred to the right side, and stiffness of the neck; no other noticeable disturbance of motion or sensation. She remained two days in bed and was able during this time to walk to the bathroom. She was unable to lift right upper lid after the accident; no swelling or ecchymosis of eye. In three days she was able to travel several miles in electric cars and climb three flights of stairs. Pain in the head, neck, and shoulders was so severe that she was unable to sleep, and was removed to a hospital. Under ice pack, electricity, and massage, neck pain and severe headaches continued. Shoulder and arm pain disappeared. She left hospital three weeks before being seen, because unrelieved.

Pain was referred to the occipital region and streamed up over the head. On any attempted motion of the head the pain shot through the right shoulder and down the arm. Coughing or sneezing caused excruciating pain.

Physical Examination.—A well-developed woman, standing with a slight deviation of the head to the right and a slight compensatory curve in the cervicodorsal region. All active and passive motions of the head were restricted and painful. A few degrees of rotation remain. The line of the spinous processes can be palpated until the axis is reached, which seems farther forward than normal. On the right side of the neck in the region of the atlo-axoid articulation there is somewhat more resistance than on the left. Pressure over this point and the corresponding region on the left causes pain. The spinal motions below the cervical are apparently normal; no paralysis; no disturbances of sensation; reflexes normal. Inspection of the mouth showed enlarged tonsils, but no inflammatory signs. Palpation of the posterior pharyngeal wall through the mouth showed a greater prominence on the right side.

From the lateral skiagraph no definite lesion could accurately be diagnosed. The anteroposterior skiagraph taken through the open mouth showed an asymmetry of the two atlo-axoid joints (rotary dislocation on the right) and an apparent fracture of the anterior arch of the atlas.

Treatment.—A Thomas collar was applied, with almost instant temporary relief. High frequency currents were given to relieve the pain, together with gentle massage, etc.

Diagnosis.—Fracture of the atlas; rotary dislocation of the atlas on the axis on the right.

Result.—One year after the accident patient has resumed her occupation as a seamstress, wearing collar much of the time, since it relieves symptoms.

CASE III. (Case of J. VAN ASSEN).—Male, 55 years of age. Since 12, occasional attacks of convulsions and loss of consciousness. Method of injury: One month before being seen slipped from a ladder, struck an open door, and fell about twelve feet on to an asphalt floor; unconscious for only a few minutes.

Immediate Symptoms.—A scalp wound demanded stitches. He remained fourteen days in bed. When the bandages were removed and he attempted to sit up he had immediate pain and stiffness in his neck. This had not been noticed in bed. In spite of massage the pain and stiffness increased. There were drawing pains also in the sides of his neck and on the sides of his occiput. There was no interference with walking or weight-bearing and no difficulty in swallowing. The head was slightly inclined to the right and fixed in slight forward bending; no visual disturbance. Mouth can be opened and tongue motions normal. In the cervicodorsal region of spine is a left convex scoliosis. At the occipito-atloid joint there is a localized deviation. The line of the spinous process is not broken. The mid-line of the face does not correspond to the mid-line of the body, but seems pushed to the right. Pain referred to the vertebral prominence and all through the neck is elicited on all active and passive attempts to lift the head from its slightly forward, bent position. Active turning of the head was impossible and passive attempts were painful. There was a little lateral motion, but accompanied by pain. There was no paralysis. The reflexes were normal and the general examination of heart, lungs, and nasopharynx was negative. There is no record of pharyngeal palpation. The lateral skiagraph showed a fracture of the posterior arch of the atlas. The anteroposterior skiagraph taken through the mouth showed the mass of the atlas higher on the right than on the left and an apparent fracture of the odontoid process.

Treatment.—Protection of the neck by means of a supportive collar apparatus.

Result.—Final relief of symptoms as long as support was worn (?).

Diagnosis.—Fracture of the posterior arch of the atlas. Probable fracture of the odontoid process. Probable rotary dislocation of the atlas on the axis on the right.

CASE IV. (Case of Dr. F. H. ALBEE, New York).—Miss S., 18 years of age. Two brothers died of tuberculosis. Six weeks before being seen patient caught a severe cold and had a stiff and painful neck. Continued at work for three weeks. On returning from work a man rushing for a car bumped into her, giving her neck a severe twist. The blow did not knock patient down, but she was immediately seized with severe pain in neck and shoulders, and her head had to be supported on her hands all the way home. She was in bed three weeks, then transferred to the Hospital for the Ruptured and Crippled, in the service of Dr. W. R. Townsend, where the following notes were made.

Patient is obliged to hold the head with her hands when sitting or standing. While lying down she usually steadies head with hand. Cervical spine held carefully and rigidly. The head is inclined forward. The cervical spine has lost its normal contour. The forward curve is much exaggerated at its upper part. Neck is tender.

A skiagraph taken soon after entrance shows an apparent separation of the atlas from the axis, the latter bone presenting no sign of an odontoid process. The atlas is more anterior than normal and there is in the skiagraph a clear space of nearly a centimetre between the bones.

Treatment.—Plaster " Minerva " jacket was applied. Later a Taylor spinal brace and chin support was fitted and in this the patient left the hospital.

Result.—Eleven months after accident still wearing apparatus and free from pain. She cannot hold the head up without some support. The spine is less sensitive to passive movements. A prominence can be felt on the posterior pharyngeal wall. Skiagraph at this time shows no open space between atlas and axis but a still existing marked forward displacement of atlas. No shadow of the odontoid process is seen.

Diagnosis.—Forward displacement of the atlas. Question of tubercular disease.

Case illustrates that the atlas can be displaced far forward without symptoms of cord pressure.

CASE V. (Case of Dr. DAVID SILVER, Pittsburg, Pa.).—S. F., age 9 years. Thirteen months before being seen one of the boy's playmates "bumped" S. F.'s head against a stone wall. Immediate soreness in the neck with some swelling on the right side ensued. Head had to be lifted from the pillow with his hands and patient would scream if not moved carefully. Pain extended up over right occiput and down the right shoulder. Improvement gradual.

Physical Examination.—Chin held slightly to the right with head tilted to the left. Movements of the cervical spine good except right lateral bending, which is moderately limited. On the right side in a spot corresponding to the position of the transverse process of the atlas a distinct bony prominence can be felt. Lateral radiograms essentially negative, except that the atlas casts a shadow more anterior than normal. Anteroposterior radiogram taken through the mouth showed a rotary dislocation of the atlas on the axis. Odontoid apparently intact. Cutaneous test for tuberculosis negative.

Treatment.—At first extension in recumbency. Later Thomas collar. Now wearing no apparatus (two years, eight months since accident).

Diagnosis.—Rotary dislocation of the atlas on the axis.

Result.—Improved position of head and freer movement. Still present (June, 1909) a slight tendency to hold the head to the left.

CASE VI.—D. F., Massachusetts General Hospital, W. Surg. Records, vol. 447, p. 101. September 8, 1903 (entrance). Five and a half months before entrance was in a railroad accident, sustaining severe scalds about shoulders and arms, and scalp wounds. The sight of right eye was destroyed. After accident head was found to be thrust slightly forward and immovable; no paralysis. Two months after accident, while head was being bandaged, something slipped, and could move head more freely. Ever since accident there has been difficulty in swallowing owing to a "ledge" in the back of his throat.

Physical Examination.—Head thrust forward and attitude like that of a stork; slight sideways and rotary motion. X-ray shows a dislocation of the atlas on the axis forward and downward, with possible fracture of the articular processes (see Fig. 10).

September 9: Manipulation under ether with head traction and rotation. Adhesions gave way, click felt, and head in more normal position; plaster helmet for one month. Head could at end of this time better be supported without apparatus. "Ledge" had disappeared from posterior pharynx, but second cervical spinous process was displaced to the left. Sent out with new plaster helmet, October 8, 1903.

Re-entry, January 25, 1904. Well up to one month ago when neck began to grow stiff and sore, and three weeks ago prickly sensation began in right hand. Two weeks ago right foot affected. At entrance loss of power in both hands and both feet and spastic condition of upper and lower limbs. Examination of pharynx shows no recurrence of "ledge."

Operation, January 29, Dr. Mixter.—Laminectomy of third and fourth cervical vertebræ. Arches of atlas, and axis found ankylosed and depressed, pressing into cord apparently from callus formation. These pressing protuberances removed. Fixed on Bradford frame. Improvement in pressure symptoms in both arms and legs continued for about four weeks.

On the night of February 26 sneezed; felt something give way in his neck and became completely paralyzed. Head traction employed without effect. Died March 1. Temperature 107.5°. No postmortem allowed.

Diagnosis.—Complete dislocation of atlas on axis. Fracture of arches of atlas and axis.

CASE VII.—J. J. C., single, laborer. The patient fell from a staging about sixty feet, striking on the right shoulder and side of the head and the neck; taken to a hospital; unconscious for sixteen hours; in bed three weeks. Head was stiff; pain on the right side of the head running over occiput, and the neck very much ecchymosed and swollen. There was difficulty in raising both arms, especially the right; no other signs of paralysis or paresis. No X-ray was taken and he returned to his home in three weeks. Pain continued; unable to be up more than for a few hours. One month ago reported at the Massachusetts

General Hospital. No definite lesion was at that time made out.

Seen by the writer seven weeks after accident. Stands with head to the right, chin to the left, with slight but distinct asymmetry (cf. Fig. 11); reflexes normal; pupils equal and react to light and distance; motions of the spine and other joints normal. The line of the spinous processes is apparently straight, not well defined in the upper part of the neck, where there is some spasm of the muscles. Voluntary forward and back motions of the head most markedly restricted. The rotation to the right is the most marked limitation of all motions. Lateral motions are quite free. All motions are painful when carried to the limits of muscular resistance. On palpation a mass can be felt between the mastoid process and the angle of the jaw on the left, more prominent than on the right. Inspection of the thorax negative, but palpation shows a greater bony prominence on the right side. Anteroposterior X-ray taken through the mouth shows no fracture of the odontoid but simply asymmetry of the two lateral masses of the atlas. Lateral X-ray shows an apparent fracture of the posterior arch of the atlas (Fig. 12).

Diagnosis.—Fracture of the posterior arch of atlas on the right. Rotary dislocation of the atlas on axis.

Treatment.—Hydrotherapy. High frequency. Thomas collar.

Result.—Gradual disappearance of pain and increase in mobility of head.

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ATLO-AXOID FRACTURE-DISLOCATION.

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As a further contribution to the subject of fracture-dislocations of the first two cervical vertebræ, which has been so ably treated in the preceding paper by Drs. Mixter and Osgood, I desire to place on record the following case which has now been under my personal observation for a period of nearly ten years and therefore fairly represents the possibilities of ultimate repair and restoration of function which may take place in such cases.

The patient, a man 33 years of age, of average good health, and a house painter by occupation, on August 6, 1900, was precipitated headlong from a ladder a distance of 15 feet, striking on his forehead. Immediately thereafter he was able to stand and walk, but was obliged to support his head by his hands. He suffered much pain which was referred to the back of his head and upper part of his neck. He was at once taken to the nearest hospital where he was retained for ten days. During this time, according to his statement, his head was notably bent over towards his left shoulder and was fixed in so great flexion that he could not open his mouth more than half an inch. He had no symptoms other than suboccipital pain and the deformity and stiffening of his neck. Still in this condition, at the end of ten days he left the hospital and returned to his home, where for two months his condition remained unchanged. During this time he was able to walk about his house but did not venture on the street. He then began to be conscious of a growing lack of power in his lower limbs, most marked upon the right side.

During the evening of October 27, 1900, while walking from his chair to the bed, suddenly his knees gave way under him and he would have fallen but for the support of one of the members of his family. He was put to bed and it was discovered that he had no control over his right arm and leg, except that he could move feebly the fingers of his right hand and the toes of the right foot. He had some control over his left arm, leg and foot, but only to a limited degree. He was unable to urinate, so that regular catheterization had to be instituted. Three days thereafter his right arm and hand had become totally paralyzed. His neck and head, which up to this time had been the seat of much pain, now ceased to trouble him except after some sudden movement.

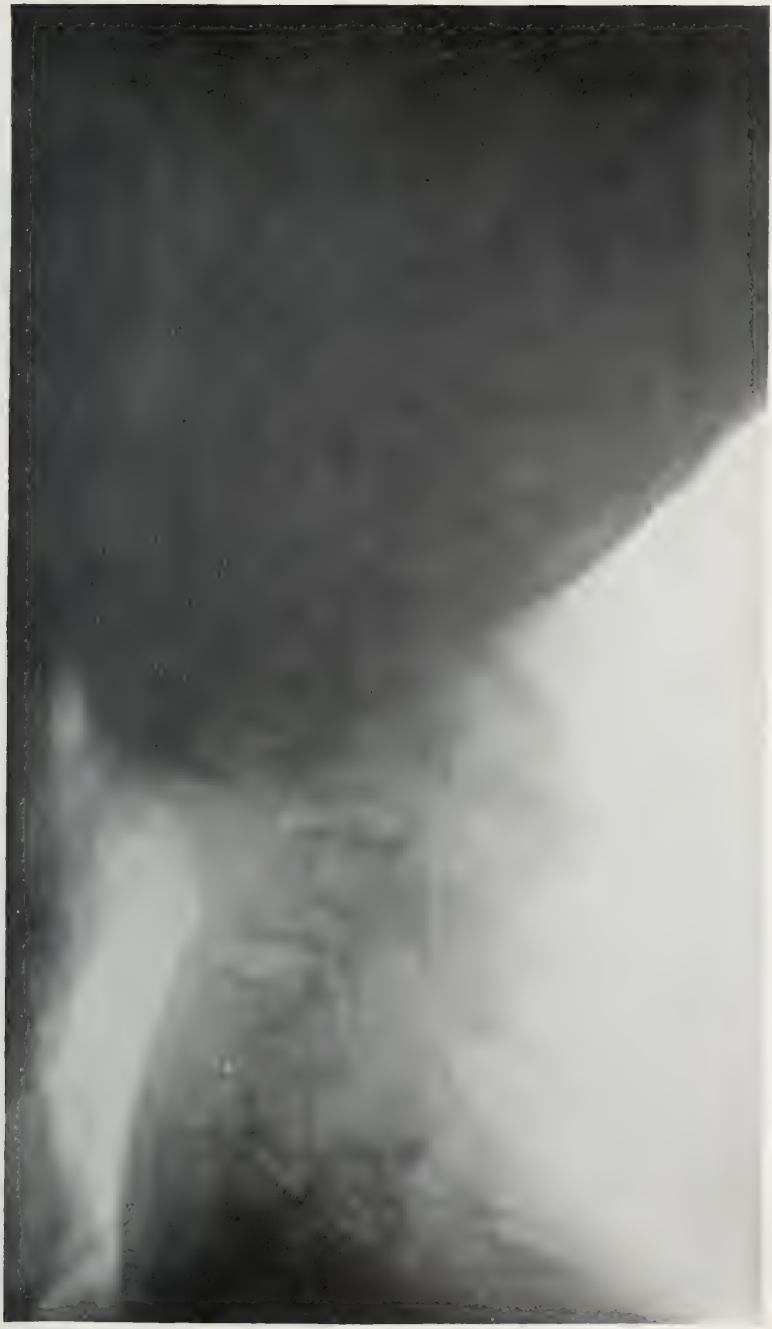
In this condition, November 7, 1900, three months after the primary injury, he was received into the Methodist Episcopal Hospital of Brooklyn and placed in my service. When received his bladder was still paralyzed, requiring the regular use of the catheter. An acute cystitis had developed. His bowels were constipated but responded to cathartics and enemata. The upper and the lower extremity of the right side were both paralyzed. To faradic stimuli there was no response in the muscles of the right forearm, except in the extensors of the thumb. Flexor profundus digitorum, very weak reaction. Lumbricales and interossei, very weak. Extensors carpi ulnaris and radialis, both very weak. On the arm proper, the biceps and the triceps gave feeble reaction. Deltoid, no reaction. Pectoralis major, feeble reaction. Shoulder muscles, very weak. In the thigh, quadriceps extensor, reaction slight. Posterior flexors of knee, reaction active. Muscles of leg, reaction slight. Diminution of temperature sense over whole right upper extremity. Pain sense absent in both upper and lower extremity. In the left arm and leg the muscular reactions were normal. The head was held in a position of rotation to the left with a curvature of the neck toward the right. No power of flexion or rotation. The outlines of the upper cervical vertebræ were obscured by an abundant dense exudate which was most voluminous on the right side. The spinous process of the axis was slightly twisted to the right of the median line. A finger passed to the back of the pharynx could appreciate a marked concavity in the anterior surface of the spinal column below the second vertebra.

At the end of six weeks' residence in the hospital his condition remained practically unchanged. In view of the possibility that the cord symptoms might in part be due to pressure from a depressed fragment of a lamina, it was decided to expose the axis and atlas. This was done December 19, 1900, through a vertical incision extending from the occipital protuberance to the level of the seventh cervical spine below. No fracture of any lamina was uncovered, but a forward dislocation of the atlas upon the axis was demonstrated to be present. Careful efforts to correct the displacement were futile. The wound was closed and the head, neck and upper thorax supported in a plaster cuirass. A smooth operative recovery followed. A slight improvement in his paralytic conditions gradually developed during the subsequent weeks. He became able to empty his bladder spontaneously and two months after the operation began to sit up. On June 8, 1901, seven months after the reception at the hospital and ten months after his injury, he asked to be returned to his home. He was still hemiplegic but had normal power over his bladder. During the entire time of his stay in hospital his appetite had always been good and his digestive power fair.

Later History.—A gradual return of power in the paralyzed leg manifested itself after his return home and continued until the normal condition was regained. Improvement also in the right upper extremity took place, but less fully than in the lower extremity.

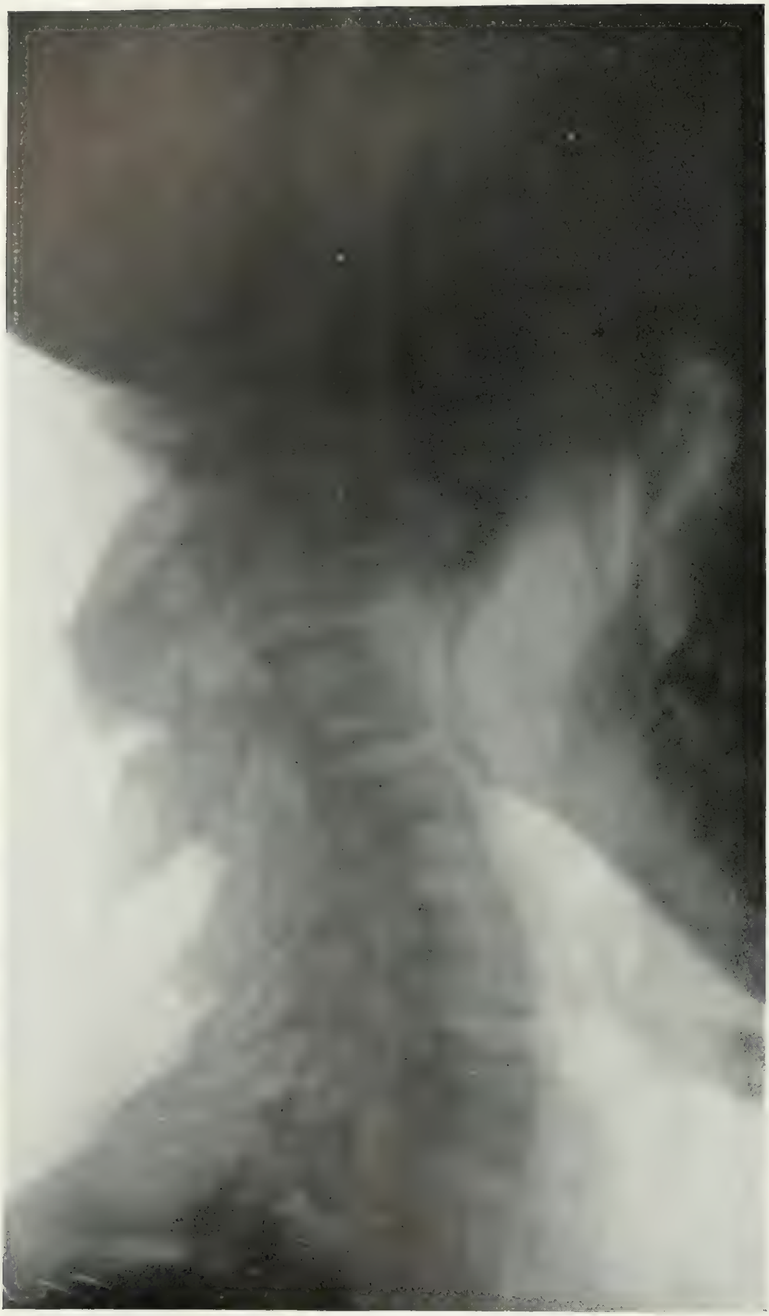
An examination made of his condition September 2, 1909, nine years after his accident, gives the following: The condition of the head and neck is unchanged as regards deformity and immobility. A dense mass as of organized callus surrounds and obscures the outlines of the atlas and fills the space between the axis and base of the skull, being most voluminous on the right side. The accompanying skiagraphs (Figs. 1, 2, 3) which were taken in August, 1909, by Dr. Charles Eastmond, reveal the outlines of the atlas and axis greatly altered and fused together in an irregular mass. There seems to have been a fracture through the lateral mass of the atlas on the right side with a crush of the body of the axis; the head and atlas with the upper portion of the body of the axis, including the odontoid process, has slipped forward and rotated to the left. He is able to walk normally fairly long distances without much fatigue. No difference of strength between the two lower limbs. He is able to elevate both shoulders, but there is a decided droop of the right shoulder. All the muscles of the right arm and forearm are less developed and weaker than those of the left arm, but all have

Fig. 1.



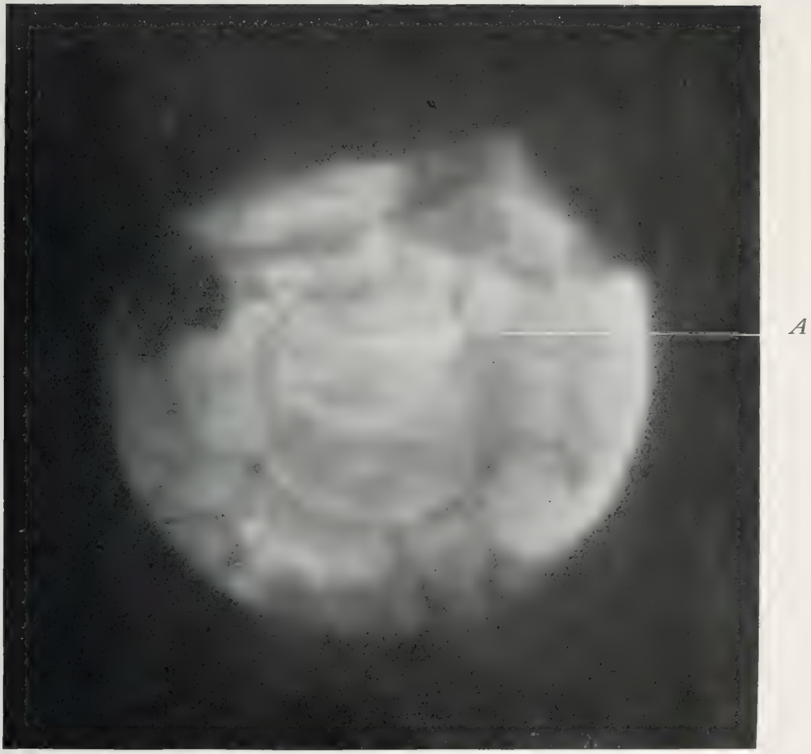
View taken with right side nearest the plate. The atlas is obscured by the tilted and rotated occiput which has brought the mastoid process into the plane of the atlas. The outlines of the axis are rendered hazy by ossified callus.

Fig. 2.



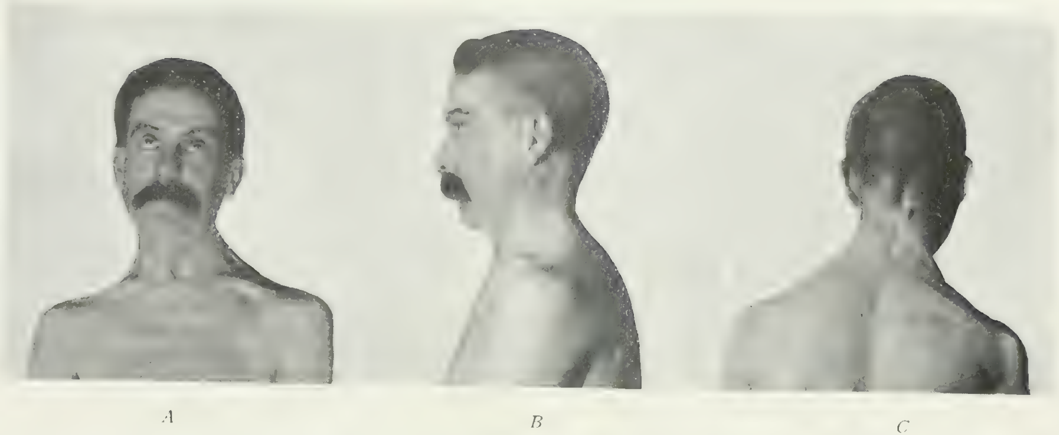
View taken with the left side nearest the plate. The outlines of the atlas are well revealed and the forward displacement of this bone upon the axis is clearly shown; the lateral masses of the atlas and the body of the axis are fused together in an irregular mass, which projects notably in front of the plane of the lower part of the body of the axis, and produces a marked angle whose apex is at the anterior margin of the cartilage between the axis and the third cervical vertebra; irregular lines are perceptible in the fused atlo-axoid mass which suggest former fragmentation of these bones; a mass of ensheathing ossified callus surrounds the lamina of the axis.

FIG. 3.



Anteroposterior view through open mouth. The structure most clearly identifiable is the intervertebral cartilage between the second and third vertebræ, marked *A*.

Fig. 4.



Healed atlo-axoid fracture-dislocation. Note in *A* the rotation of the chin to the left and the bend of the head to the right (reversed in the photograph). Note in *B* the pose in which the head is rigidly held. Note in *C* the scar of operation in the midline of the neck. The dark spot to the right of the upper part of this scar is a dot of iodine placed to mark the location of the spine of the axis.

regained some power; extension and flexion at the elbow is normal in range. Pronation and supination of forearm are normal in range. The right hand presents to a moderate degree the condition of *main en griffe.* The flexor carpi ulnaris and radialis are contractured, as is also the flexor profundus digitorum. Extensor carpi radialis and ulnaris are too weak to overcome the flexors, so that the hand is held in position of flexion with extension of the first row of phalanges and flexion of the two distal rows. The lumbricales and interossei are normal. The muscles of the thumb are normal. He can approximate the thumb and first digit. There is no power to grasp by the hand as a whole. The left lower extremity is normal. The bladder functions are normal. His mentality is unaffected. Appetite and digestion good. Bowels move regularly. His general health is good.

The accompanying photographs (Fig. 4), were taken January 1, 1910, to show the present condition of this man. There is no motion, either of flexion or rotation of the head upon the neck; the bony ankylosis between axis and atlas, and the atlas and occipital bone is apparently complete. The rotation of the head to the left, and the inclination of the head to the right is well shown.

MALIGNANT DEGENERATION OF BENIGN DISEASES OF THE BREAST.*

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THE advances made in surgery of the mammary gland have been due, to a considerable extent, to the aid furnished by pathologic studies. The subject of benign tumors of the breast was obscured for many years by a lack of uniformity in nomenclature, a confusion which has been dispelled by a suitable classification of these affections. Recent pathologic studies of benign breast diseases have elicited a very important fact, namely, that a fairly high percentage of the benign tumors and diseases of the breast undergoes a secondary malignant degeneration. A study of certain types of benign tumors, with the object of determining the approximate percentage of malignancy and the signs by which it can be recognized, should be of value from the prognostic and surgical standpoint.

In reporting the following cases, Warren's[1] classification has been followed. The cases examined are used as types of the various benign affections, the discussion following is based upon the most important recent communications of the subjects in question.

Fibro-epithelial tumors.—Warren divides these tumors into two divisions—the fibrous type and epithelial type. In the first group are included the periductal fibroma, the periductal myxoma and the periductal sarcoma. The second division comprises a class of tumors which are rather uncommon—the cystadenomata—which are subdivided into the fibrocyst-adenoma and the papillary cystadenoma.

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* Read before the Philadelphia Academy of Surgery, Nov. 1, 1909.

The periductal fibroma (adenofibroma) occupies an important place from the standpoint of frequency, occurring in 7 per cent., whereas the entire group of fibro-epithelial tumors comprises 11 per cent. of the entire number of breast diseases. Warren has advocated the terms "periductal fibroma" because the chief constituent of the fibro-epithelial tumors of the fibrous type is the peculiar periductal tissue of the breast. This tissue develops at a time when the majority of the fibrous tumors occur, between puberty and lactation; it is part of the structure of the breast, and its close relationship with the epithelial elements makes it impossible for one type of tissue to undergo tumor formation without involvement of the other. The name "adeno" is reserved by Warren for the tumors in which the epithelial elements play a more important part.

The clinical features of periductal fibromata are too well known to warrant any extensive discussion, although certain deviations from the usual type encountered are of interest. The growth occasionally progresses steadily until it reaches enormous size, weighing, in some of the cases, as much as eight or ten pounds. In such instances, as reported by Finsterer,[2] Anger[3] and others, the patients are advanced in years (forty to fifty) and the growth is of many years duration. Cases have been reported in which benign tumors have been present for a period of ten to twenty years before malignancy developed. Ulceration of the skin, cystic degeneration of the tumor, a constant increase in pain and enlargement of the axillary lymphatic nodes may occur. Such symptoms are highly suggestive of malignancy, but microscopic examination of the tumor may not show evidence of carcinomatous formation. Fortunately this type of rapidly growing but benign tumor is becoming rare, because few are permitted to reach such size without operative interference. Therefore, the more common type encountered is the small, well circumscribed, single or multiple tumor. Sufficient histologic evidence is present to prove that this form becomes malignant, although clinical facts pointing to a recognition of this complication are not numerous, and not infrequently the microscope shows quite accidentally that the tumor removed has undergone carcinomatous degeneration. Anger[3] reports a case in which islands of cancer were present in a fibroadenoma, which in spite of its large size (7 k.) and long duration did not appear malignant. The skin was normal, the tumor freely movable and the axillary lymphatics were uninvolved.

Microscopic studies of the secondary epithelial changes in benign tumors have been more numerous in connection with abnormal involution and with the cystadenomata. While fewer cases are on record of malignancy occurring in periductal fibroma, yet the underlying changes are practically the same as in other conditions. Kuru[4] believes that the carcinoma, in such instances, arises by means of active epithelial growth which is associated with a simultaneous adenomatous proliferation, and he agrees with Müller,[5] that the process begins as a multicentric formation. Some pathologists deny that cancer occurs secondarily to benign tumors, and claim that it takes its origin from misplaced cells,—that the two tumors grow independently and finally become associated by the enlargement and infiltration of the carcinoma.

Sudden enlargement of a previously existing latent tumor should always be regarded as a suspicious symptom. Axillary involvement is not always conclusive, as it may be of inflammatory origin and was found by Finsterer[2] seven times in sixty-four benign conditions of the breast. Rapid growth of a benign tumor may be associated with ulceration, loss of weight and weakness, so that the symptoms of an early cachexia are simulated.

A tumor, previously movable on the underlying structures, which becomes adherent presents one of the most reliable signs of malignancy; but this symptom does not occur until the disease has become well advanced. Dimpling or adherence of the overlying skin should always be regarded as highly suggestive of carcinoma. Pain seems to be a variable symptom in benign lesions of the breast. Its occurrence has been noted by many writers, but when associated with rapid enlargement of the tumor (and particularly when the severity of the pain constantly increases) a malignant degeneration should be suspected.

Statements as to the cause of malignancy in benign affections are rather scanty although traumatism and pressure are supposed to play an important rôle. Elsasser[6] observed a case in which exposure was said to have caused rapid growth and malignancy of an adenofibroma. An hereditary predisposition was present in both of the cases which this author has recorded. An associated mastitis or lactation may be injurious to benign tumors; the effect of pregnancy is discussed under the second case reported. Several of the cases recorded have occurred in women who have never borne children, nor have suffered from previous diseases of the breast.

We find, therefore, that certain tumors which present symptoms suggestive of malignancy do not show the histologic changes of the same, and, on the other hand, carcinoma occasionally arises in a prëexisting tumor without causing symptoms indicative of such a transformation. We can conclude from these statements that operative interference in all tumors of the fibro-epithelial type is indicated to prevent this complication.

In the Laboratory of Surgical Pathology, University of Pennsylvania, two instances of carcinomatous changes in periductal fibroma have been observed in 17 cases studied pathologically. In both there were one or two symptoms which were only suggestive of cancer. In the first case the skin was not freely movable over the tumor, and in the second an enlarged hard axillary lymph-node was present. Beyond these doubtful symptoms, there was no evidence of carcinoma which was not seriously considered in either case.

The clinical histories and pathologic descriptions of the two cases follow:

Case I.—M. J., aged 45, unmarried, was admitted to Dr. Frazier's service for a growth in the left breast of seven months duration. The tumor was not painful, had grown slowly until it reached the size of an egg, and seemed to the patient, to be slightly more fixed than formerly. Patient cannot recall any injury to the breast, and she has never had any soreness of the nipple. The tumor was situated to the right and passed beneath the nipple which is normal. The skin was movable over the growth but not freely, and the tumor was entirely movable over the chest wall; it was not painful on palpation, but hard. The axillary lymphatics were uninvolved.

Operation: The tumor was found to be well encapsulated, presenting the characteristics of a benign growth; it was not deemed necessary to perform a more radical operation than removal of the tumor with the surrounding skin and all glandular tissue—a precaution which was made on account of the patient's age. The patient recovered from the operation and when seen 22 months later showed no signs of a recurrence.

Specimen on examination consists of the breast, and surrounding fat. The skin is freely movable and unchanged in appearance, the nipple slightly retracted. A small nodular mass is palpable through the skin but has no relationship with the nipple. On the posterior surface a well circumscribed, round encapsulated tumor the size of an egg is seen embedded in the breast tissue. The mass is not adherent to the surrounding tissue and presents on section a reddish white appearance. The red areas are soft, contain a few small cysts, and are directly continuous with the white indurated portion which cuts with more difficulty than the other part of the tumor. The induration is almost the size of a pea, and represents but a small proportion of the tumor from which it so differs in appearance that the impression is given of tissues of different type. The remaining portion of the breast on careful examination, particularly the nipple region, is free from gross change.

Microscopically, the sections taken from the tumor show a proliferation of the periacinous fibrous connective tissue which is quite cellular and completely surrounds the ducts and acini. The latter are regular in appearance, and are lined for the most part by a single layer of cuboidal epithelium. Many of the ducts are dilated, forming small cysts, the lining cells are low and a few papillary projections are seen within the lumen. The fibrous overgrowth has compressed many of the cystic dilatations so that they appear as slits, resembling the form of tumor described as pericanalicular fibro-adenoma.

The second portion of the growth retains the appearance of a periductal fibroma, but in addition an epithelial hyperplasia is present. This occurs in many of the acini and ducts which are filled with cells which have no tendency to infiltrate the fibrous stroma. The cells, for the most part, are regular in appearance; in some acini many layers are present and here some irregularity in the shape of the epithelium is seen. In many areas the circumscribed appearance is lost, and the epithelium infiltrates the connective tissue spaces as thin lines or processes. In other places the cells are heaped up and form small collections in the tissues; a glandular reproduction, however, is not present. The tissue in which the malignant degeneration has arisen is to a slight extent invaded by leucocytes, shows considerable dilatation of the blood-vessels and some free blood in the tissues.

Examination of the breast tissue surrounding the tumor and in the neighborhood of the nipple shows changes of involution. Pathological diagnosis: Periductal fibroma, carcinomatous degeneration.

Case II.—The patient, aged 45, had noticed a growth in the upper and outer quadrant of the right breast for six years. It was painless, of slow growth, and did not produce any symptoms. Her last child was born 10 years ago; she has not had any previous breast disease. About four months ago she became pregnant, and shortly afterward noticed that the tumor began to enlarge, but did not become painful. On examination a small, well circumscribed tumor was discovered in the breast and a single enlarged node in the axilla. In view of the rapid enlargement and lymphatic involvement, her family physician advised removal of the tumor, which was done by Dr. A. C. Wood.

Specimen consists of a tumor about the size of a hazel nut, the surface is pale and the cut surface smooth and rather fleshy in appearance. The tissue is arranged in concentric bundles, and has a firm consistency. Attached to the tumor is a mass of fat and muscle tissue in which there is but one small piece of indurated material which shows a firm white focus.

Microscopic sections were taken from the lymph-node removed from the axilla and the breast tumor. The breast tissue has the typical appearance of a periductal fibroma, the ducts and acini being surrounded by periacinous tissue, and do not show any cystic changes. The epithelium is hyperplastic, as in the previous case and again has the tendency to fill the ducts and acini, and in many areas has broken through its normal limits and has invaded the fibrous stroma in the form of cellular processes somewhat resembling an early form of scirrhus. The lymph-node shows slight hyperplastic changes but no metastatic growth. Pathological diagnosis: Periductal fibroma, beginning carcinoma.

The active state of the breast incident to pregnancy undoubtedly was of great importance in promoting the malignant degeneration in this case. The epithelium of the periductal fibroma, already in a state of instability by reason of proliferative changes aided by the advanced age of the patient, was thus readily transformed into a malignant process. As the tumor was well circumscribed, the lymph-node uninvolved and the carcinoma of an early form, the patient is being carefully observed, a more radical operation not being performed. Without removal of the tumor, and with increasing functional activity of the gland, a form of rapid carcinomatous involvement of the entire breast, such as is frequently seen during pregnancy and lactation, may have developed.

Abnormal Involution.—For the sake of uniformity in following Warren's classification the above term is adopted. The older name, "chronic cystic mastitis," advocated by König, is still used by many writers, and while it suggests to the pathologist the exact condition in the breast, yet by many it has been confounded with acute pyogenic mastitis. König[7] and others believe the disease to be infectious in nature, and by a few it is described as a tumor formation. Recent studies, however, assign the cause to certain abnormalities occurring in the breast during its involution. These changes consist largely in hyperplasia of the epithelium incident to cyst formation, produced in turn by fibrous overgrowth. The tendency toward uniformity in classification of breast disease is gradually being extended to this type in which heretofore the greatest difference and laxity in nomenclature has existed. Thus we find that Theile[8] in his study concludes that fibro-adenoma, cystosarcoma phyllodes and chronic cystic mastitis form a group of diseases which arise from the same elementary histologic changes, and which are distinguished from one another by a more or less pronounced encapsulation, through the predominating growth of the connective tissue in some and the epithelium in other cases. The original process is to be regarded as neither inflammatory nor as a tumor formation, but as a form of fibro-epithelial degeneration which may manifest itself in one of the tumor formations named. Further evidences of regression are seen in malignant degeneration of the connective tissues into sarcoma, or the epithelial elements into carcinoma. The latter variety is much the more common, although a few instances of sarcomatous transformation have been recorded. Early malignant change as such can probably be recognized by the microscope only, the two varieties producing symptoms which can not be differentiated.

Two varieties of abnormal involution may be distinguished, the cystic and proliferative. The latter class is divided into three subdivisions: (1) Proliferation of the acini, (2) papillary outgrowths of epithelium into cysts, and (3) adenomatous proliferation of epithelium. While the difference of these subgroups is mainly histologic, the degree of epithelial proliferation varies so much that they should be briefly discussed. According to Warren's summary, we find that the first type shows an increase in acini which is accompanied in the majority of instances by a proliferation of the epithelium to such an extent that thickened or even solid columns of cells are produced, retaining, however, the formation of the gland ducts, and presenting no infiltration beyond the basement membrane. While the significance of this form is not determined, it may lead to carcinoma.

In papillary proliferation we find a growth of epithelium in the cyst cavities of such a nature that the cells are heaped up and project into the cavity without a connective tissue pedicle. The picture suggests that more epithelium is produced in the lining of the cyst walls than can be accommodated on the basement membrane, and is thus thrust into the cyst cavity.

In the third group, adenomatous proliferation is met with, and only in cases in which papillary outgrowths are already present. This form represents a more advanced type of epithelial hyperplasia, and is, therefore, most commonly associated with a carcinomatous degeneration. Nine of Warren's cases were seen in connection with involution changes of the papillary and adenomatous types. Bloodgood[9] has observed more malignant than benign cases of this variety. The five cases of adeno-carcinoma which I have studied showed adenomatous proliferation in each instance. The acinal type of abnormal involution is more likely to degenerate into a scirrhous variety of carcinoma, as occurred in three of Warren's cases, and in one of my series.

Abnormal involution occurs more frequently than any other affection of the breast, with the exception of carcinoma. According to Warren, it constitutes 15 per cent. of all breast diseases, and Bloodgood states that it is seen in 25 per cent. of all benign cases. An analysis which I have made of 180 cases of breast disease shows that it occurred in 18 per cent., and of the 35 cases studied in this laboratory 9 instances of malignancy were encountered (26 per cent.). The following table represents the number of cases of abnormal involution studied by different observers and the number of malignant cases in each series:

	No. of cases	No. carcinoma.
Warren[1]	115	15
Greenough and Hartwell[10]	30	3
Sasse[11]	9	2
Ruloff[12]	11	4
Lichtenbahn[13]	5	0
Theile[8]	19	3
Verga[14]	28	5
Schimmelbusch[15]	43	3
Speese	35	9
Total cases	295	44

Carcinomatous, 15 per cent.

A malignant degeneration in 15 per cent. of the cases represents the general opinion of many observers who have studied this disease. In the cases observed 26 per cent. were found to be malignant, a percentage somewhat higher than other writers. The diagnosis of malignancy depended on the general aspect of the epithelium, the regularity of the acini, penetration of the basement membrane and tendency toward invasion of the stroma. The size of the cells is also to be considered, for irregularities in size and shape is suggestive of carcinoma. The presence of clear, vacuolated cells (*blasse Epithelien*) indicates proliferative changes, as pointed out by Müller and Theile, and when present in abnormal involution, is not diagnostic of carcinoma.

The symptomatology and gross pathologic changes of abnormal involution are so well understood that time will not be taken to describe them. In general, the diagnosis of the condition, especially the diffuse variety, is not difficult. Malignancy is more likely to occur in women past the forty-fifth year of life. In the nine cases reported the youngest patient was 35, the oldest 65, and the average age 47. In many instances the disease had lasted but a few months from the time of observation until operation was performed. In Bloodgood's experience the duration of the disease has been less than four months in cases in which the clinical diagnosis is doubtful. In the adenomatous variety, we find too, that the growth is apt to be more rapid than in the cystic type. In the majority of early cases there are no signs by which a malignant degeneration can be diagnosticated. Enlargement of the axillary lymph-nodes, slight inversion of the nipple, induration of the tumor, pain and tenderness, rapid growth and discharge from the nipple are all symptoms seen in non-malignant cases. The diagnosis of early malignancy will have to be made in the majority of instances at the time of operation, when incision into the suspected area will disclose the carcinomatous tissue.

In doubtful cases exploratory incision is indicated; a careful search throughout the entire part involved is necessary, for the malignant area is apt to be quite small. Malignancy being detected, a radical operation should be performed. In case of doubt, the entire breast should be amputated, and if the axillary lymph-nodes are enlarged they should be removed. The exploratory incision does not reduce in any way the chance of ultimate cure, whereas exploratory incision followed by the radical operation for malignancy at a later period has been invariably fatal according to Bloodgood. In the majority of cases studied, the carcinomatous area has been small, so that if dependence is placed upon frozen sections made at the time of the operation, great care must be observed to select a suspicious area. As one becomes familiar with the gross changes of this disease, less attention will be paid to frozen sections and the diagnosis will be made from the macroscopic appearance. Malignancy is often so early that careful study of specimens hardened to cut in the usual manner is necessary before the diagnosis can be made. For this reason, I have gradually given up the use of the freezing microtome as a diagnostic aid, and place entire dependance on the naked-eye appearance of the affected tissue.

The bilateral character of the disease is one of its interesting features, and one for which occasionally double amputation has to be performed. Several instances have been observed in which patients have been forced to undergo secondary operations on the opposite breast after having had one amputated for abnormal involution. If indurated areas are present in both breasts, especially in women over forty, a bilateral operation should be performed, and both breasts, or the diseased areas removed. Many of the cases of bilateral carcinoma recorded have in all probability originated in abnormal involution which began as a bilateral affection in both breasts. Case XI of the series supports this view, for in each breast definite carcinomatous nodules were present in association with the changes of abnormal involution.

Certain instances of abnormal involution appear to undergo spontaneous cure, the contents being discharged through the nipple, or the cyst rupturing. More frequently a stationary stage may be encountered, or the epithelial proliferation advance to malignancy. Cases are encountered which probably represent the initial changes of abnormal involution, definite areas of induration are not palpable, but more or less discomfort is experienced. In this type careful observation may be employed, but in no other form of abnormal involution are temporizing methods to be tolerated, because of the danger of cancer.

Case III.—Mrs. M. S., aged 55, service of Dr. Edward Martin. Mother of several children, no previous breast disease. Two years ago the patient received a severe blow on the left breast which has been painful since the accident. About six weeks ago a small nodule was noticed in the breast. There was slight pain and tenderness, the skin and nipple normal, and on palpation the tumor was hard, not larger than a hazel nut and adherent to the surrounding tissues. The axillary nodes were not palpably enlarged.

Specimen (2497) is a breast with underlying muscles and axillary tissues. On section a hard nodule about 1½ cm. in diameter is found which shows a fine yellow mottling at the centre surrounded by a translucent greyish tissue which sends off fine fibrous processes into the surrounding tissue, and by contracting cause a puckered appearance at this point. Throughout the process there is considerable greyish parenchyma which seems increased and more fibrous than normal, but nevertheless there are no frank characteristics of malignancy except at the one point first noted. The nodes in the axilla are very slightly enlarged, soft, and grossly do not suggest metastasis.

Microscopically the breast tissue near the growth is very fibrous in appearance and contains numerous small cysts. The glandular acini are slightly increased in number and are so compressed by the fibrous tissue that they resemble the cellular processes of a scirrhus. In some areas a moderate hyperplasia of the epithelium has occurred in the acini. While the abnormal involution here seems to be of the cystic type, slight hyperplasia is present. Numerous sections do not reveal a process which can be regarded as predisposing to cancer. That this must have occurred somewhere in the process of abnormal involution is shown in the sections taken from the dense nodule, where the compressed epithelium is seen surrounded by a dense fibrous stroma—the picture being a typical scirrhus.

Diagnosis: Abnormal involution (acinal type). Scirrhous carcinoma.

Case IV.—Mrs. M. M., aged 44, service of Dr. J. W. White. About one year ago the patient noticed that the left breast was somewhat larger than the right. One month ago she received an injury of this breast, and noted then for the first time that several hard nodules were present. Since then she has had pain and the tumors have increased slightly in size. She has had two children, but did not nurse either one. The nipple and skin are both normal, and the nodules do not seem adherent to the surrounding parts.

The specimen (2237) obtained by the operation consists of two portions of breast tissue measuring about 14 x 6 cm. Two distinct processes are seen in the breast, the first a rather diffuse infiltration of dense, glistening, whitish tissue in which a few cysts about the size of a pea are present. This process is not very marked, and extends through a small portion of the breast. The second process consists of a soft pinkish mass of tissue about the size of a hen's egg which shows softening and degeneration in its centre. Section through the latter demonstrates a dense mass which is adherent to the surrounding breast tissue.

Microscopic examination of the first process shows marked increase in the number of acini, in which the epithelium is slightly proliferated. The stroma is dense and contains but few cells. Cyst formation is inconspicuous and proliferative change, beyond that noted, is not present.

The soft tumor mass reveals evidence of extensive leucocytic reaction which in some places obscures the tumor tissue. The latter is seen as collections of large and slightly irregular epithelial cells occurring in masses and showing mitosis. The inflammatory reaction which extends to the surrounding tissues, was probably caused by the injury received.

Diagnosis: Abnormal involution (Acinal type). Carcinoma.

Case V.—Mrs. M. O., aged 46, service of Dr. Edward Martin. Patient received a blow over the left breast 17 years ago. Shortly afterward she noted a lump in the breast which did not enlarge until four months ago when it began to increase in size and became painful. There was no discharge from the nipple, the tumor was freely movable and the axillary nodes uninvolved. The breast was removed, the pectoral muscles and the axilla were not disturbed.

The specimen (2501) showed a fibrous and cystic process which was diffuse in character. Microscopically the sections taken from different portions of the breast reveal in most places a typical appearance of abnormal involution with great production of fibrous tissue compressing the ducts, in some places giving rise to small cysts. The epithelium of the acini is hyperplastic and the basement membranes often poorly defined. In a few places the proliferation is so great and its appearance so atypical that it is impossible to interpret the processes as simply due to pressure from overgrowth of fibrous tissue. Several large masses of cells which show mitotic figures and of invasive tendency are seen. In addition to these changes in the acini other areas show papillary proliferation in the cysts; the epithelium here is quite different in appearance from that of the tubules and cysts seen elsewhere. The cells are larger, the protoplasm is pale and has a vacuolated appearance. The nuclei are small and are deeply stained. In general the epithelial growth is toward the lumen, and the basement membrane is well defined. Occasionally the arrangement is lost and the appearance is that of an epithelial invasion.

The process is regarded as malignant, and certainly suggests the multicentric origin of carcinoma in this instance, for the cancer although early, is apparently arising in two different ways: (1) secondary to acinal proliferation, and, (2) as the result of papillary proliferation.

Diagnosis: Abnormal involution (acinal and papillary types). Carcinoma.

Case VI.—Mrs. F. M., aged 45, service of Dr. J. W. White. About one year ago noticed a small nodule at upper margin of left breast, and a few weeks later a second one in the axilla. At that time both nodules were freely movable and not painful, but later grew rapidly. About ten months later the nodule in the breast was removed and sent to this surgical laboratory and reported as carcinomatous. A few months later she entered the hospital because of the formation of other tumors in the breast, and in the axilla. At this time the mass in the breast was firmly adherent to the surrounding tissues, the nipple and skin were retracted.

The specimen (2030) consists of an amputated breast, the elliptical section of skin measuring approximately 12 x 4 cm. in length and breadth. The nipple is not retracted, but at the opposite extremity of this elliptical section of skin there is an old scar about 1 inch long running at right angles with the long axis of the skin section. Palpation over this scar reveals the presence of a mass buried beneath the skin and superficial fascia. Incision through the pectoral muscles and fascia on the inferior aspect of the breast displays a mass about 1½ inches in diameter and of a dirty, grayish brownish coloration surrounded by a mass of white fibrous connective tissue. Incision through the tumor itself displays surfaces of a mottled, reddish and grayish coloration, the red areas being quite friable.

Microscopically the tissue in the involuting portion of the breast is very fibrous, and contains a few small cysts. In these papillæ are seen, and in others the epithelium is atrophic from pressure. The tendency toward adenomatous formation is not marked. The carcinoma appears as a dense collection of cells in which necrosis is present (medullary form) and as atypically developed acini (adenocarcinoma).

Diagnosis: Abnormal involution (proliferative form). Medullary and adenocarcinoma.

Case VII.—Service of Dr. J. B. Carnett. Patient aged 43 years, single, has had several operations on the right breast, two cysts being removed, the tissue, however, not being examined microscopically. For several months she has suffered with pain in left breast, which on examination contained three distinct cysts, one to the inner side of the nipple, and one each in the upper and lower outer quadrants of the breast. The tumors were freely movable, the lymph-nodes not enlarged, the skin not involved. Operation: plastic resection, all glandular tissue being removed because of the extensive involvement.

The specimen (1589) consists of two masses of tissue, one about the size of an egg, the other the size of the palm of the hand. Both have the same characteristics, and contain many cysts which vary from a pea to a hazel nut in size. The tissue on section is dense in quality, fibrous, and cuts with some difficulty.

Microscopically many small cysts containing papillæ are present, the lumen of some is filled with a homogeneous secretion and desquamated epithelium. The lining cells are cuboidal in shape, the acini are increased in number and many of them are filled with cells some of which are cuboidal and others cylindrical. The epithelial hyperplasia also occurs in the form of rather cellular collections in which a few atypical acini can be distinguished. They are found in the fibrous stroma, unlimited by a basement membrane and infiltrating the tissues.

Diagnosis: Abnormal involution (acinal and papillary proliferation) Adenocarcinoma.

Case VIII.—M. C., aged 65, service of Dr. J. H. Jopson, Presbyterian Hospital. About 10 years ago patient had the right breast amputated for carcinoma. There has been no recurrence of trouble since the operation until four months ago when she noted a lump in the upper and outer quadrant of the left breast. On palpation this was found to be tender, rather diffuse in character and freely movable. In the axilla several enlarged lymph nodes were present which seemed to be adherent to the surrounding structure. A clinical diagnosis was made of carcinoma secondary to abnormal involution, and the breast amputated.

The breast (1963) was found to be the seat of a diffuse fibrous and cystic overgrowth, and in one area a dense mass the size of a walnut was detected. The axillary nodes were hard, and of the same character as the small tumor in the breast.

Microscopically the usual picture of abnormal involution is seen, papillary and adenomatous proliferation of the epithelium is present, the papillæ almost filling some of the cyst cavities In the immediate vicinity of the cyst, the cells have infiltrated the tissues forming carcinomatous masses in which there is an attempt to form acini. The cells in these areas are irregular in size and shape and show many mitotic figures. In the stroma leucocytic infiltration is marked.

This patient developed local recurrence and died three years later. The autopsy showed a single carcinomatous nodule in the liver, pathological fracture of the femur due to metastasis and skin metastases.

Diagnosis: Abnormal involution (papillary and adenomatous type). Adenocarcinoma.

Case IX.—Mrs. J. G., aged 55, service of Dr. Edward Martin. The patient was admitted for removal of a growth in the right breast. This on examination was in the outer quadrant, was dense in character, the skin and nipple were not adherent, the axillary lymphatics were uninvoluted. The breast was amputated, and on careful inspection did not show any gross evidences of cancer. The process present (2434) was diffuse and fibrous in nature, pinkish-white in color, and contained numerous thin-walled cysts whose contents were clear. The cyst walls were smooth and did not reveal any papillary growths.

Microscopic examination shows a marked overgrowth of the connective tissue, the nuclei being abundant showing an active proliferating process. Along with the connective tissue changes there is a considerable hyperplasia of the glandular acini which are present in great numbers. The epithelium is in an active state of proliferation; fills many of the acini, some of which are dilated. Small papillæ project into the cysts which are quite small. In the adenomatous parts some of the acini are quite irregular in shape and are closely packed together; toward the periphery of the areas the acini have no regular basement membrane. The cells are without definite arrangement in the connective tissues in some places, in others the form of acini is assumed. The epithelial cells do not show marked deviation from the normal type, although some irregularity in their size is present. About the adenomatous areas the tissues are invaded by leucocytes, and the stroma here is more cellular than elsewhere.

Diagnosis: Abnormal involution (adenomatous type). Adenocarcinoma.

Case X.—Mrs. J., aged 40, service of Dr. A. C. Wood. One year ago she had a small tumor removed from the right breast which on examination proved to be carcinomatous in nature. Immediate amputation of the breast was advised but refused. In a short time the growth reappeared, and X-ray treatment was begun. This was continued for a year, 80 treatments being given; the tumor, however, increased, so that surgical interference was again sought.

The breast was amputated, and on opening the axilla enlarged lymph-nodes were not found.

The specimen consists of a breast with some axillary lymphoid tissue. To the breast is attached the pectoral muscle and a large amount of fat. The skin with nipple attached does not shown any abnormal changes or retraction. Cross section through the breast shows a rather diffuse whitish infiltration which resembles the fibrous tissue changes following involution. A few small cysts are present which contain a clear secretion. At one corner of the breast directly above the pectoral muscle but not attached to it, is a nodule not larger than a pea, which is hard, indurating in character and infiltrates the breast tissue. This is the only macroscopical evidence of malignant disease which is present. The fatty tissue removed from the axilla is perfectly normal in appearance.

The sections were taken from the tumor and the fibrous tissue. In the latter the process is benign and consists of a marked fibrous overgrowth in which a few cysts appear. The acini are increased in number and in a few as well as in some of the ducts, the epithelium is proliferating, and appears as minute papillæ. The cells of these papillæ are slightly irregular in shape, and in many of them the protoplasm is quite clear. The nuclei are deeply stained and regular in size. There is no attempt in these areas for the cells to break through the basement membrane of the glands. In the stroma a round cell reaction is present.

The sections taken from the tumor show a well-advanced carcinoma which is embedded in a dense fibrous stroma. The tumor cells form rather dense masses and have undergone necrosis in many places, probably the result of the X-ray treatment. A connection between the benign disease and the carcinoma is not seen microscopically. The lymphatic tissue is normal.

Diagnosis: Abnormal involution (acinal type). Carcinoma.

Case XI.—B. W., aged 35, service of Dr. C. H. Frazier. Has had three children but no previous breast disease. About two years ago she noticed small lumps in each breast, the growth of which have been gradual, have caused pain and have given the patient considerable anxiety. On examination, the nodules are about the size of a hazel nut and freely movable. The axillary lymphatics are uninvolved. As an abdominal operation had to be performed, it was thought advisable to remove the breasts.

On examination both breasts show practically the same characteristics, being the seat of a diffuse fibrous overgrowth in which numerous small shot-like cysts appear. This tissue while firm is not dense in quality and contains embedded in it several small pinkish white nodules which are adherent to the fibrous stroma. These nodules are hard and dense when compared with the other process and cut with great difficulty. In the left breast, one of the nodules slightly infiltrates the pectoral muscle which is attached to the breast.

Microscopic examination of the stroma shows a slight fibrous overgrowth of the periacinal tissues, which is quite cellular. Numerous dilatations of the ducts and acini are present and in these the epithelium is heaped up in masses and in the form of papillæ. There is no evidence of malignancy until the sections taken from the small nodules are examined, when a marked cellular hyperplasia is encountered. The stroma is relatively slight in amount—the acini and ducts filled with cells and papillary formations. In the stroma, the acini are arranged in an irregular manner and much epithelium is present in small ill-defined masses. The carcinoma in the left breast is more advanced in type than that of the right.

In this case a malignant degeneration had arisen without causing any marked symptoms.

Diagnosis: Bilateral abnormal involution (adenomatous proliferation). Bilateral adenocarcinoma.

Cystadenoma.—The epithelial type of the fibro-epithelial group of tumors is less important than the fibrous variety from the standpoint of frequency, occurring in only 2 per cent. of the cases. Warren subdivides this group into fibrocystadenoma, and papillary cystadenoma.

The fibrocystadenomas are regarded as an exaggeration of the periductal fibroma from which they differ by the secondary proliferation of the epithelium. The tumors occur in young single women, are of slow growth, of long duration and are generally painless. While the prognosis is favorable in this class, the degree of epithelial hyperplasia makes a carcinomatous degeneration likely, so that removal of the tumor should always be practised.

In the papillary cystadenoma we have a more common and at the same time more dangerous affection. Clinically we have to deal with a tumor formation seen in advanced life and especially in women who have borne children. As in the first variety, the tumor is slow in growth, of long duration, and is usually situated near the nipple, from which a bloody discharge occurs in the majority of cases. While they rarely attain large size, and are almost always slow in growth, such complications may arise and make the diagnosis of a malignant degeneration most difficult. The following case occurring in Dr. Frazier's service illustrates this fact.

CASE XII.—Surgical pathology (2562). The patient is single, 22 years of age, and has always been perfectly well with the exception of her breast condition. This began eight years ago when she noted a small lump in the right breast, which followed a blow received a short time previously. The tumor was painless and showed no tendency to grow until 18 months ago, when enlargement and pain began. This has continued until the growth is as large as a child's head and causes discomfort from its weight. The mass involves the entire breast, is not adherent to the underlying structures, and the skin is freely movable except at one point near the nipple. Several soft cystic spaces which are surrounded by dense tumor tissue are noted. There has been no discharge from the nipple, several axillary nodes are palpable. The case was regarded as malignant from the history and the entire breast and axillary lymphatics removed.

The specimen on examination shows an encapsulated mass which is neither adherent to the skin or the pectoral fascia beneath. Near the nipple a round reddish encapsulated tumor about the size of an egg is present. From the base of the fibrous capsule many fine papillæ project and almost fill the cavity. This tumor is distinct from the mass which occupies the remaining portion of the breast, which presents a dense white appearance, and is divided by numerous septa into small nodular masses. The tissue is unyielding and fibrous and in a few places only shows a tendency toward papillary formation, as in the smaller growth first described.

Microscopically two distinct processes appear to be present in the breast. Sections from the dense tissue show a process resembling periductal fibroma. Here the stroma is very cellular, indicating an active proliferative process, and surrounds the ducts and acini. In the latter the epithelium is in a state of hyperplasia, forms a lining composed of several layers, has filled the lumen in a few acini and in others lines delicate papillæ. The cells are cuboidal in shape, regular in outline and some have the pale translucent appearance seen in proliferating epithelium. In the small tumor a similar fibro-epithelial hyperplasia is apparent, but in this case the epithelium is even more active, and papillary formation marked. The cystic spaces here are in places almost filled with papillary overgrowth, but careful examination of many slides does not show any malignant tendency in spite of the general proliferative change. The axillary nodes were not involved in a metastatic growth, but were hyperplastic.

The process is a cystadenoma in which the papillary character is seen in the small growth, the fibrous form predominates in the remaining portion of the breast.

From the very rapid growth of this tumor, its size, long duration and pain, a malignant degeneration was suspected. The degree of hyperplasia of both epithelial and connective tissues proves that such a process was imminent, and that the tumor was probably removed prior to such a transformation.

When malignancy is about to develop in such tumors, they apparently undergo a variety of changes and degeneration. Gassert[19] reports a case of cystadenoma and carcinoma in which he found areas resembling the lactating breast, simple cystic dilatation, adenomatous formation with cystic degeneration, papillary proliferation and finally carcinoma. He believes that the adenomatous proliferation and the cysts were independent.

The difficulty in differentiating malignancy in early cases of this disease is emphasized by a comparison of the rapidly growing benign tumor just reported with the following instance of malignancy, in which the size, clinical history and pathologic findings of the case differ materially.

Case XIII.—Surgical pathology (1425), service of Dr. Edward Martin. Mrs. S., aged 35, married, mother of several children. No previous breast disease. A few weeks ago she noted a small tumor in the right breast which was painless, originated without any cause so far as could be ascertained, and was freely movable. The tumor was not adherent to the skin, there was no discharge from the nipple which was slightly inverted.

On opening the cyst which was about the size of a walnut, a bloody fluid escaped. The lining was smooth except at one point where a small papillomatous nodule, red in color projected.

Sections for microscopic examination were taken from the small papilloma and the portion of the cyst wall from which it grew. The epithelium lining the papillary projection is very irregular, appearing in one or more layers of cells which are very irregular in their shape. In other areas the papillæ have fused so that a dense collection of cells appears. In the stroma irregular acini are seen, the cells here present irregularities and do not completely surround the lumen, occasionally all attempt toward glandular formation is lost and cellular masses lie in the tissues without a limitating membrane. Some of these cellular collections containing atypical acini are found in the fatty tissue of the breast directly outside the cyst wall, and indicate that the process is extending to the surrounding parts.

Diagnosis: Papillary cystadenoma; adenocarcinoma.

A radical operation was refused in this case. Eighteen months later the patient was found to be free from any breast disorder.

The cystadenoma have been studied carefully by many pathologists and especially with the object of determining the probability of a malignant degeneration. Greenough and Simmons[20] found adenocarcinoma associated in 15 per cent. of twenty cases. The cancer appeared to be associated with the existence of the papillary tumor, and the type was the same in all three instances. Reliable symptoms of early malignant degeneration are wanting, for we find that the malignant papillarycystadenoma occasionally is of long duration, and may be seen at a fairly early age. The diagnosis must therefore be made at the operation, when inspection of the cyst and the surrounding tissues will reveal any infiltration. In certain cases of malignant papillomatous cysts which Bloodgood has observed, the diagnosis could be made clinically from the history of long duration of the tumor, discharge of blood from the nipple with retraction of the same and skin involvement. Such breasts revealed a pathologic picture entirely different from benign cysts; instead of a papilloma in the wall there was a soft fungus growth resembling a medullary carcinoma. In diagnosing these cases much emphasis should be laid upon the character of the cyst contents as well as in cancer cysts to be considered later.

Cancer Cysts.—By this term is meant a malignant transformation in the wall of a benign cyst, a class of cases distinct from the cystadenomata, and the cystic changes seen in abnormal involution. While the origin of the cancerous degeneration is not quite clear, the retrogressive changes which the epithelium undergoes can be regarded as responsible. The lining cells of the cyst become compressed or atrophied, and in addition retrograde changes in the fibrous wall may occur, these factors playing a more or less important rôle in the degeneration which may follow. The origin of the cancer is not so important when once the disease is well established, for then a radical operation is indicated. The diagnosis in early cases, from the purely clinical stand-point, presents the same difficulty as is encountered in other instances of malignancy secondary to benign affections—reliable evidences of the metamorphosis are wanting. Here again the exploratory incision and examination of the cyst must be our method of diagnosis. Bloodgood[21] states that this depends upon the contents of the cyst, if bloody and a benign papilloma is not present, a cancer should be suspected. Granular or grumous material in the cyst should lead to the diagnosis of cancer of the cyst wall. Palpation will also be of great value in detecting the presence of small carcinomatous nodules, or diffuse infiltration of the wall. In certain instances the wall becomes rough or reticulated, which in the presence of hæmorrhagic contents, as in a case I have recorded elsewhere,[22] should lead to the diagnosis of cancer. In the cancer cysts in particular, Bloodgood emphasizes the greater certainty in diagnosis from the gross appearance than from rapidly frozen sections.

Mastitis.—The relationship between inflammatory affections of the breast and the development of carcinoma at a later period has been recognized for many years. Two types of mastitis are important in connection with carcinoma; in the first the inflammation is associated with a very rapid and malignant growth of the tumor, so that the entire breast becomes involved. This form is uncommon, is most frequently seen during pregnancy or lactation, which states seem to hasten the process. Volkmann has given the name "carcinomatous mastitis" to this disease; by others it has been termed "acute carcinoma."

By far the more important group of infections coming under the scope of this paper are encountered in the inflammations which occur as complications of lactation, the tissue changes resulting act as the predisposing factor in the development of cancer. A similar effect is seen in the granulation tissue caused by the healing of wounds, or hæmatomata following traumatism. The scar thus formed does not possess the resistive power of normal tissue, and constitutes a locus minoris resistentiæ. Chronic irritation then occurring in an individual whose vitality is diminished by old age may cause proliferative changes in the epithelium, which growing deeper and deeper into the breast finally become malignant and appears as a carcinoma. Guleke [16] believes that the epithelium which undergoes such proliferation arises from ducts and acini which are cut off by the contracting scar tissue.

The presence of points of induration or distinct nodules as after effects of inflammation or traumatism, and the many clinical reports of carcinomatous formation in direct relationship with such areas, indicate clearly that we have to deal with a condition which may be more common than suspected. While statistics cannot be relied upon to furnish us with absolute proof of the occurrence of mastitis previous to the development of cancer, yet the reports published indicate that such inflammation has existed in 10 to 20 per cent. of the cases. The time elapsing from the inflammation until malignant metamorphosis ensues varies from several weeks to many years, in advanced cases 20 to 30 years may elapse before severe pain and rapid enlargement indicate that carcinoma may be developing. Such symptoms, on the other hand, are not always present, for Steinthal[17] records an instance in which a small carcinoma was accidentally found in a mass of chronic inflammatory tissue. Many cases of carcinoma are seen in which a previous mastitis has not caused changes in the breast recognizable by palpation. Whether the malignant degeneration here is independent of the previous inflammation or not, is difficult to determine. Scheurer[18] believes that although an apparent restoration to the normal state has occurred, yet certain minute changes are present, which remaining latent for years, finally through some unknown irritation, manifest themselves as a malignant tumor.

From a practical stand-point, the question can be raised whether we are justified in permitting areas of induration to remain, especially if the patient is near the menopause. Certainly in view of the possibility of cancer, such cases should receive as careful attention as other forms of benign disease, early removal of which may prevent cancer and its greater danger.

The author wishes to express his thanks to Dr. J. W. White, Dr. Edward Martin, Dr. C. H. Frazier, Dr. A. C. Wood, Dr. J. H. Jopson, and Dr. J. B. Carnett for permission to use the clinical data of the cases reported.

ACUTE INTUSSUSCEPTION OF THE ILEUM WITH VOLVULUS.

BY CHARLES L. SCUDDER, M.D.,

OF BOSTON, MASS.

Surgeon to the Massachusetts General Hospital; Lecturer on Surgery in the Harvard Medical School.

A young male adult, M. G., who had been in previous good health excepting for one attack of abdominal pain a year ago, was suddenly seized with intense pain in the abdomen upon a Monday. During the first 24 hours there were no other symptoms. The pain persisted. The man felt sick and went to bed. He was seen by a physician on Tuesday, who found that the pain was rather general throughout the abdomen below the level of the umbilicus rather than above it. There was a slight elevation of temperature—between 99 and 100 degrees. The pain persisted through Tuesday night. On Wednesday morning the patient vomited once, the temperature reached 100.2.

When I examined the patient I found the following situation: A relatively young man, under thirty, who looked sick. The tongue was slightly dry in the centre but moist on the edges. The abdomen was slightly full. The abdominal muscles were everywhere contracted so that the abdomen felt firm. No masses could be felt in the abdomen. It was possible to determine no focal point of tenderness. The patient had just previous to my examination passed a large quantity of bloody liquid from the bowel. Rectal examination disclosed nothing unusual.

We have here then, a young adult suffering from a sudden acute attack of persistent abdominal pain without marked temperature, with one bloody discharge from the rectum. The abdominal pain in the absence of fever suggested at once a mechanical obstruction to the bowel. Operation found a small amount of free fluid in the abdominal cavity. This fluid was not bloody. Below the umbilicus and at the centre of the abdomen was found a mass which consisted of an intussusception of the ileum twisted upon itself (Fig. 1). It was impossible to reduce the intussusception although the volvulus could be untwisted. The mass was delivered outside of the abdominal cavity. The intussuscepted mass was resected and is shown in Fig. 1. The mesenteric vessels were ligated, the ends of the divided small intestine were closed by encircling purse-string sutures and interrupted sutures. A lateral anastomosis between the proximal and distal portion of the gut was then done. The abdominal wall was closed without drainage. The patient made a satisfactory recovery. (Fig. 2 shows the line of the abdominal cicatrix.) Evidently the occasion for the intussusception was the pedunculated tumor (seen in Fig. 2) which lay within the lumen of the bowel.

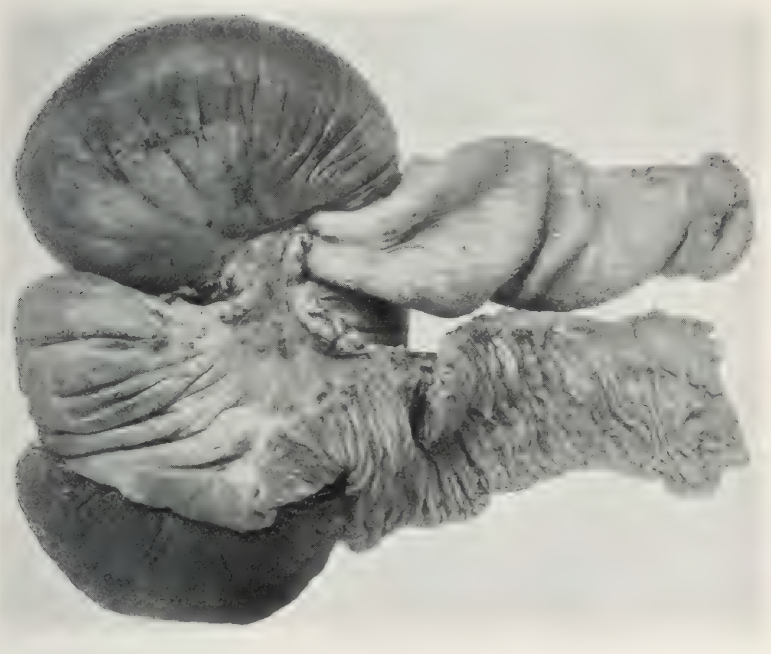
REPORT FROM THE CLINICO-PATHOLOGICAL LABORATORY OF THE MASSACHUSETTS GENERAL HOSPITAL.

Report upon the examination of tumor in a case of intussusception and volvulus, by Dr. Oscar Richardson, the Assistant Pathologist.

Dissection of the intussuscepted intestine shows a distinct, roughly spherically shaped tumor about 3½ cm. in diameter arising from the mucosa of the intestine on a short pedicle. The tissue of the tumor is dark blackish-red and it is necrotic looking.

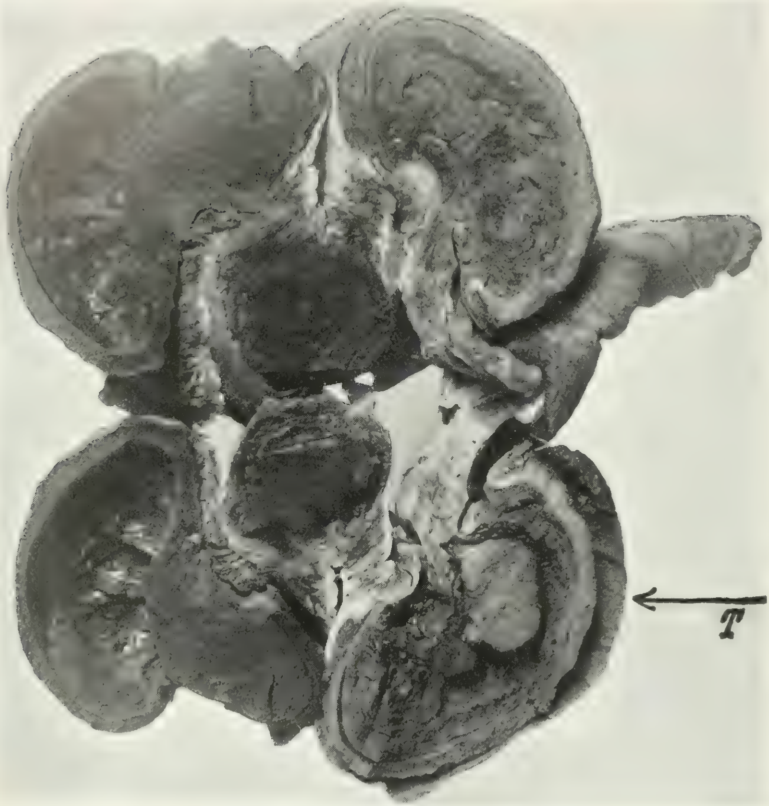
Microscopical examination of hardened and stained sections shows faintly outlined, ill staining, necrotic-looking epithelium arranged in tubular formation and supported by an ill staining, necrotic-looking reticulum of connective tissue. Owing to the condition of the tissue of the tumor the sections are not as satisfactory as could be wished, but the tumor is regarded as being a *pedunculated adenoma.*

Fig. 1.



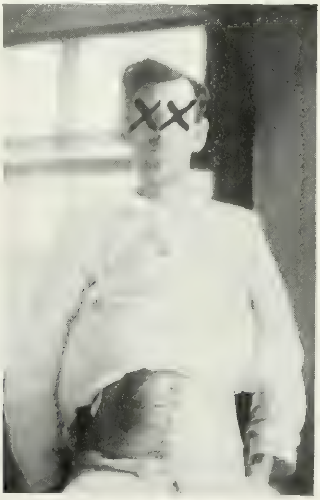
Intussuscepted mass excised. Note evident impossibility of reduction; wide margin to divided gut; lower arm of gut opened longitudinally, showing enclosed nose of intussusception.

Fig. 2.



Intussuscepted mass sectioned. The various intestinal walls can be partly traced. At lower part of specimen is seen at *T* a pedunculated tumor, the probable occasion for the intussusception.

Fig. 3.



Note abdominal cicatrix. At the middle of cicatrix was found the tumor.

A METHOD OF ANASTOMOSIS BETWEEN SIGMOID AND RECTUM.

BY DONALD C. BALFOUR, M.D.,
OF ROCHESTER, MINNESOTA,
Surgical Assistant in St. Mary's Hospital.

THE inaccessibility of tumors of the lower sigmoid at or near the junction of rectum is attested by the unsatisfactory results following the usual methods of operating on this class of cases. Resection of the growth with an end-to-end anastomosis has always been attended by a high mortality: a permanent colostomy renders the patient a nuisance to himself and friends, at least for a time; and any attempt to join the cut end of the proximal sigmoid to the sphincter ani means the unnecessary sacrifice of the rectum. The following method of dealing with such cases has been employed during the past three years at St. Mary's Hospital by Dr. W. J. Mayo, with satisfaction (*Montreal Medical Journal,* October, 1909).

For some years it has been the practice here when the lower sigmoid has been accidentally injured, especially where the bowel wall has been infiltrated with inflammatory products, to assist the closure of the intestinal opening by the use of a tube support. A three-fourth inch rubber tube with a lateral eye near the extremity (to permit the escape of gases should the end become obstructed) is passed through the anus and rectum up beyond the site of operation, and there anchored by a catgut stitch. This served so well to carry off the intestinal products and proved to be such an admirable splint for the sutured bowel, that the idea was suggested of using the tube following extensive resection of the sigmoid. The successive steps in the operation can be briefly tabulated as follows:

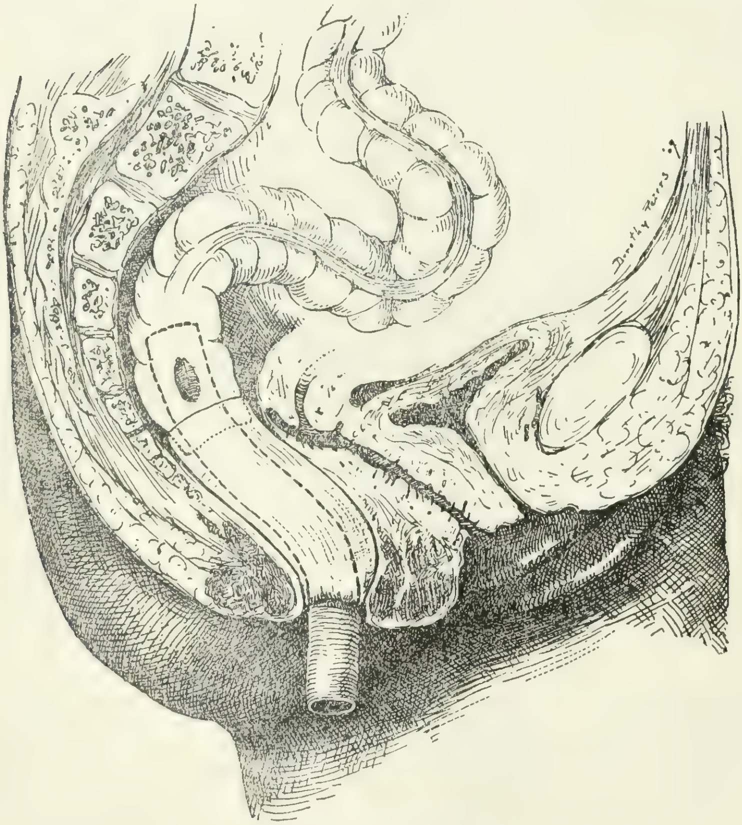
1. The patient is placed in a high Trendelenberg position

and a long median incision made between umbilicus and pubes.

2. The intestines are carefully packed off above, leaving only the lower sigmoid exposed in the pelvis.

3. Liberation of the affected portion of the bowel by lateral incisions through the peritoneum, especially through the outer leaf of the sigmoid, and a semilunar incision along base of bladder connecting the two lateral.

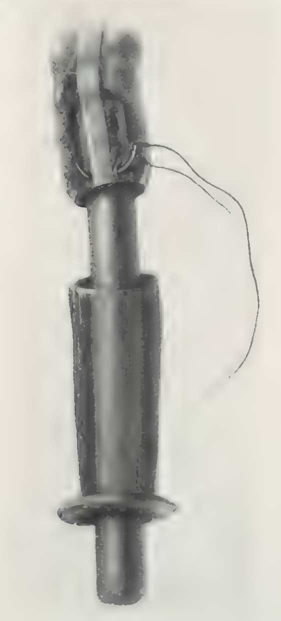
Fig. 4.



Profile drawing of median section of pelvis showing completed anastomosis.

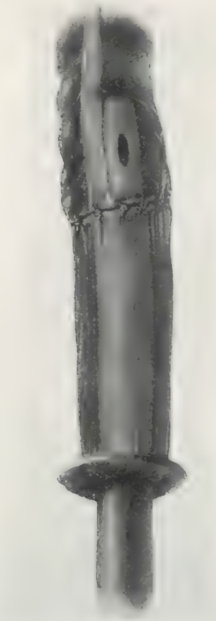
4. Careful dissection of all the fat and glands as high as the abdominal aorta, the hollow of the sacrum being swept clean.

FIG. 1.



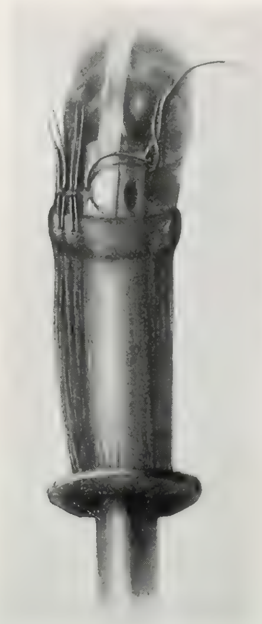
Showing tube introduced through rectum up into proximal sigmoid, and placing of catgut suture.

FIG. 2.



Showing tube used for bringing the two ends into apposition and first row of sutures placed.

FIG. 3.



Showing intussusception accomplished and outer row of sutures placed.

5. Ligation of the inferior mesenteric and middle sacral arteries at proper points.

6. Two pairs of forceps are clamped on the bowel at a suitable distance below the tumor and two on the proximal side; the necessary amount of sigmoid with the tumor excised, and the cut ends sterilized.

7. A three-quarter inch rubber tube is passed into the lower segment of bowel until the end protrudes through the anus: the upper end with lateral eye is inserted into the proximal end of the sigmoid to a distance of some three inches. It is here secured by a transverse catgut stitch one half inch above cut end of the intestine (Fig. 1).

8. Traction is made by an assistant upon the end of tube projecting from the rectum, until the cut ends of the bowel meet, and the anastomosis is made by interrupted through-and-through chromic catgut sutures with careful coaptation of the mucous membranes (Fig. 2).

9. Traction is again made upon the tube sufficient to accomplish a half-inch intussusception, this being aided by a few forceps on the distal fragment to steady it, and a second row of seromuscular sutures is inserted. Sometimes the parts are so deeply situated that the second row cannot be well placed, but the ultimate result has been good nevertheless (Fig. 3).

10. The defect in the peritoneum behind is remedied by sliding the peritoneum and suturing, and finally the omentum is drawn down over the anastomosis, and if necessary secured by a catgut suture.

11. The abdominal wound is closed in the usual way, drainage being provided for, as a rule, by two wicks carried down on each side of the anastomosis into the hollow of the sacrum, and brought out the lower part of the abdominal incision. The rubber rectal tube remains in position about six days, until the catgut suture is absorbed. The abdominal drains are loosened on the fourth to the sixth day, but usually not removed for a week because a temporary fistula sometimes occurs.

EXCISION OF THE RECTUM FOR CANCER BY THE PERINEAL ROUTE.*

BY CHARLES H. PECK, M.D.,

OF NEW YORK CITY.

Surgeon to the French and the Roosevelt Hospitals; Adjunct Professor of Clinical Surgery in Columbia University.

While the combined method of excision of the rectum for cancer is ideal in its free access to the higher lymphatics and the possibility of exact determination of the upper limits of the disease or the presence of secondary deposits elsewhere in the abdomen, it has certain disadvantages as compared to the perineal route which cannot be ignored. Moreover, in a large number of growths below the middle of the sacrum (a frequent site and the only one in which the perineal route should be considered) its advantages are theoretical rather than practical, for recurrence in these cases is usually in the immediate vicinity of the primary growth. It is quite possible in these low-lying tumors to remove by the perineal route a sufficient length of bowel above the growth and also the lymphatics in the hollow of the sacrum, the real difficulty being to get beyond the disease in its immediate vicinity owing to the proximity of the adjacent organs and the lateral pelvic structures. This difficulty is in no wise diminished when the combined method is employed, for this part of the dissection is of necessity done from below. If in all cases of combined excision a permanent inguinal anus is made at the outset, as advocated by Blake, the greatest dangers of the method are obviated; but it is even then a more dangerous and severe operation than excision by the perineal route. If, after section of the bowel at or above the promontory, an attempt is made to bring

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* Read before the New York Surgical Society, Nov. 10, 1909.

the proximal segment down to the pelvic floor the danger is greatly increased owing to the uncertainty of getting a sufficient length of viable gut. That a permanent inguinal anus is as satisfactory to the average patient as one at the natural site if even partial control is preserved, I cannot believe, in spite of many statements to the contrary. It is infinitely better, however, than a gaping posterior opening high in the sacral region, with no control whatever, a result sometimes seen from attempts to remove the higher growths from below,—and I believe the latter should be operated on by the combined method with the formation of a permanent inguinal anus. The two cases presented to-night upon whom I have operated during the past year and a half, will serve to illustrate some of the advantages of the perineal operation which I wish to emphasize.

The first, a man 57 years of age, was operated upon at the Roosevelt Hospital on August 19, 1908, and presented to this society a year ago. He is still without recurrence and has good sphincter control.

The second, a man 37 years of age, was operated upon at the French Hospital on January 21, 1909. He had a constricting growth about four inches from the anus, and at the time of operation, the obstruction which had developed gradually was nearly complete, and there was marked distention. A description of the operation performed will illustrate the method which I have employed.

Operation.—The patient was placed in the dorsal position, hips elevated on a sand bag, buttocks projecting well over the end of the table. The anus was closed with a purse-string suture of heavy silk. A posterior median incision was carried backward a little beyond the base of the coccyx and prolonged forward on either side of the anus as a shallow Y. The coccyx was excised, the incision deepened, and a finger hooked over the posterior border of the levator ani facilitated its division close to the rectum on either side. The rectum was then freed by blunt dissection in its entire circumference, above the sphincter, below the growth; double ligated with tape at a safe distance from the growth, divided and the cut ends seared with the cautery. The peritoneum was then opened, gut with growth freed from bladder, prostate, lateral pelvic walls and hollow of sacrum, and drawn down a sufficient distance to allow the proximal segment to come well within the sphincter. It was double ligated above the growth, divided and cauterized. Thus far, theoretically, there had been no opportunity for contamination from the lumen of the gut. It was now necessary to open the anal segment and excise its mucous membrane. The wound was carefully protected with gauze pads, the anal purse-string suture removed and the lumen cleansed with peroxide, after which the tape ligature above the sphincter was cut away, the segment with sphincter split posteriorly and its mucous membrane excised. Without removing the tape ligature the proximal segment was brought out through the sphincter and secured with two rows of chromic gut sutures, its ligated end projecting nearly two inches. The wound closure was made by suture of peritoneal edges to the gut wall, of the cut edges of the levator ani muscles posteriorly, and of subcutaneous fat and skin. A good-sized rubber tissue and gauze drain was passed from the upper angle of the wound to the hollow of the sacrum. Complete suture of the sphincter around the bowel was not possible—a small defect being left posteriorly.

In spite of the intestinal distention present at the time of operation, the gut was left closed for forty-eight hours when, as a spontaneous opening had occurred near one of the stitches at the anal margin, the projecting necrotic portion was cut away and the bowels allowed to move. Enormous quantities of fecal matter were passed during the next two or three days, all through the sphincteric ring. The gut remained viable to a little beyond the anal margin in front, and to within half an inch of it posteriorly. The posterior suture line held throughout without infection, and there was never any fecal leakage at the drainage track. In view of the distention and marked degree of obstruction at the time of operation, I feel that the protection of the wound from fecal soiling for even forty-eight hours, was very satisfactory and an important factor in preventing infection in the wound. The patient is now well, without recurrence, has a fair amount of sphincter control and is able to follow his occupation as a waiter in a large restaurant.

With the technic described—which is simple—the perineal operation is considerably shorter and less severe than the combined operation and is applicable to a large number of low-lying growths. By leaving the bowel closed for from two to five days or even longer, a principle which I have employed for several years, healing without infection of at least the greater part of the wound can be obtained in many cases. As pointed out by Mayo, clean healing, by preventing inflammatory infiltration of the tissues about the sphincter, is probably a great aid in preserving a fair degree of control. The splitting of the anal segment posteriorly enables one to leave the anterior attachments of the sphincter undisturbed, and to thus protect at least a part of its nerve supply.

The choice of a method for excision of malignant growths of the rectum must always remain a matter requiring careful consideration in each individual case, but I believe that the perineal route is still the preferable one in a considerable number of properly selected cases.

THE TREATMENT OF GANGRENE OF THE FOOT BY ARTERIOVENOUS ANASTOMOSIS.*

BY GEORGE P. MULLER, M.D.,

OF PHILADELPHIA.

Associate in Surgery in the University of Pennsylvania; Assistant Surgeon to the University and Philadelphia Hospitals; Surgeon to St. Christopher's Hospital.

It is not necessary to refer at this time to the brilliant series of experimental observations whereby it has been shown that it is possible to divert the blood from an artery to a vein by an end-to-end anastomosis of the two vessels. The work of the experimental laboratory has been applied to the human being, and in this paper I report the tenth case in which an attempt has been made to stay the advance of gangrene of the leg.

In 1902 San Martin, stimulated by the work of Gluck, reported that he had operated upon two patients suffering from gangrene of the leg. He performed a lateral anastomosis between the femoral artery and vein. In one case amputation was performed at the same time and there was no further spread of the gangrene; the other was a complete failure. In the same year Jaboulay reported a similar operation on a patient suffering from gangrene produced by endarteritis. It was not successful and amputation became necessary later.

Hubbard in October, 1906, recorded the case of a man, aged 80, in whom he established an end-to-end anastomosis, by the invagination method, between the femoral artery and vein in Scarpa's triangle, for senile gangrene of the foot. A double anastomosis was done to effect reversal of the circulation. While no pulsation was observed, the leg did not become swollen or cold, its nourishment apparently being satisfactory. The gangrene spread until the lower half of the foot became blue and a line of demarcation appeared. Amputation was then performed.

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* Read before the Philadelphia Academy of Surgery, November 1, 1909.

Torrance in 1906 made an end-to-end anastomosis of the anterior tibial artery and internal saphenous vein in a case of crush of the foot and leg. The anastomosis sloughed.

Lilienthal in 1907 operated on a case of angiosclerotic gangrene and performed an end-to-end anastomosis in Scarpa's triangle. Eighteen hours later a line of demarcation formed, crossing the upper portion of the dorsum of the foot, thence up the sides of the leg and crossing the calf 7 or 8 inches above the point of the heel. Death occurred 31 hours after operation from shock. An examination of the anastomosis showed a smooth union with an extremely soft clot in the vein, possibly formed just before death, when the circulation was at its lowest ebb.

In 1907 Hubbard reported his second case in which the anastomosis was done by the invagination method, the distal end of the artery and the proximal end of the vein being ligated. The case was a distinct failure as it was necessary 10 days later to amputate above the knee.

In May, 1908, Ballance reported a case of arteriovenous anastomosis for senile gangrene in a woman aged 75. The gangrene began in the toes and three weeks later the skin over the dorsum of the foot began to show discoloration. An end-to-end anastomosis was performed. A few hours after operation the internal saphenous vein could be felt pulsating and visible pulsation was seen in the veins on the dorsum of the foot, but this did not persist, as two days later the pulsation was barely perceptible. "The immediate effects of the operation were striking; arterial blood was transmitted by way of the veins to the foot, the warmth of the foot was increased, the advance of the gangrene (obvious before the operation) was stayed, a definite line of demarcation appeared on the inner three toes, and the skin proximal to the line of demarcation again became sensitive so that light touches were readily located." From this time on the gangrene of the foot was arrested. Four months later the patient was seized with acute abdominal pain and died 24 hours later. Autopsy disclosed a gangrenous condition of the cæcum, ascending and transverse colon. The anastomosis between the femoral artery and the vein was closed by scar tissue.

In July, 1908, Wieting, of Constantinople discussed the operative treatment of angiosclerotic gangrene and reported a successful case in which he intubated the femoral artery into the femoral vein. The patient, a man 40 years old, had had the right leg amputated a year previous. The foot and ankle were cold, and livid in color, and the seat of tingling pain; the patient stated it was exactly as the other foot had been at one time before the progression of the gangrene warranted amputation. Immediately following the anastomosis the foot became warm, the toes red and the pains and paræsthesia disappeared. No pulsation of the veins was seen or felt. Two months later the foot was warm and all symptoms had disappeared.

In November, 1908, Lund reported that he had operated upon a man, 32 years of age, who suffered from coldness and mottling of the foot, several sluggish ulcers on the dorsum and toes and absence of the posterior tibial and dorsalis pedis pulse. The condition had been caused by frost-bite nine months previous, although even before this he had had pain and a tingling sensation in the left foot. An end-to-end anastomosis of the femoral artery and vein was made with mattress silk sutures, everting the intima. The foot immediately turned from white to a deep pink and the superficial veins filled out. The first toe became gangrenous and was removed 11 days later and as the flaps became gangrenous the leg was amputated, three days later, 4 inches below the knee and the wound healed by first intention.

In the same year, December, 1908, Hubbard reported a third case of a woman, 84 years old, who three months before had had an amputation done of the right leg above the knee for gangrene of the foot. Subsequently a necrotic ulcer appeared on the left heel, and fearing gangrene an arteriovenous anastomosis was done according to Carrell's method. Two weeks later the foot was warm and comfortable and the patient up in a wheel chair. Five weeks after operation "it was noticed that without any apparent reason the whole leg had become decidedly œdematous. From this time there was no very marked changes in the local condition except that a cool area about 3 inches wide, encircling the middle of the leg, appeared, while the foot and upper leg remained warm. The sloughs on the heel and over the big toe began very gradually to extend and a bed sore which developed over the sacrum showed no improvement. The general condition of the patient became gradually poorer and she gradually failed and died from senility" 9 weeks after operation. Examination of the site of anastomosis after death showed perfect healing but a thrombus at the point of union was found which was undergoing organization. The age of the thrombus could not be decided and the result was, therefore, in doubt.

The next case was reported by Armour and Smith in September, 1909. The patient, a man 69 years old, complained of swelling, cold, and feeling of pins and needles in his right foot. The arteries were tortuous and thickened, the pulse tension not high and the circulation very sluggish. The pulse could be felt in the right femoral artery but not in the popliteal below it. An end-to-end anastomosis was done and the internal saphenous ligated in the upper part of the thigh. Four days later a line of demarcation formed at the level of the upper and middle thirds of the leg on the outer side and of the lower and middle thirds on the inner side. Above this the leg was warm and the superficial veins were actively conveying blood and were somewhat distended but not pulsating. Fourteen days later the leg was amputated above the knee and when the tourniquet was loosened the tied vein was seen actively pulsating just as an artery would. The latter was filled with clot. The popliteal vein was found thrombosed below the highest set of valves.

Three weeks ago, October 7, 1900. Hubbard reported his fourth anastomosis for senile gangrene in a man aged 77 years.

An end-to-end anastomosis was done by the Carrell method. At the close of the operation the circulation in the foot returned as quickly as before. The discoloration and mottling of the foot were greatly improved but pain was marked. Later œdema of the leg appeared and pain was so great as to require morphine. About five weeks after the anastomosis, amputation above the knee was necessary owing to the pain. When the tourniquet was loosened red blood was seen to spurt from the femoral vein.

To these cases I wish to add the following:

J. F. M., aged 51 years, was admitted to Dr. Frazier's service in the Philadelphia Hospital, June 29, 1909. Two weeks before admission his left foot began to pain and tingle and to become blue, cold and mottled. When admitted he was found to have a gangrenous fifth toe and gangrenous patches on the remaining toes. He was poorly nourished, tall and gaunt and had marked arteriosclerosis of the radial and temporal arteries. The dorsalis pedis pulsation could not be felt. He was treated along the usual lines until July 19, 1909, when it was feared that the gangrenous process was advancing. On that day, under spinal anæsthesia, end-to-end anastomosis was effected, by the Carrell method, of the femoral artery and vein at the apex of Scarpa's triangle below the origin of the profunda femoris. Complete reversal was not attempted. The artery was moderately sclerosed. When the clamps were removed the vein was seen actively pulsating and continued to do so during the closure of the wound with catgut for the deeper tissues, silkworm gut for the skin. The leg and foot became warm, the leg red and the foot reddish purple in color. No visible pulsation of the veins was observed. In 48 hours the foot was cold to the ankle, the leg warm and on the third day a line of demarcation began to appear at the tibiotarsal joint. This became more marked in a few days and amputation at the middle third of the leg was advised but the patient refused to have it done. From this time until September 3, 1909 (40 days), the patient was absorbing toxin from the gangrenous foot and was gradually getting weaker. About September 1, he became delirious and, permission being obtained from his relatives, the leg was amputated 4 inches below the knee. At this time the posterior tibial and peroneal veins showed feeble but distinct spurts of blood. There were many unusual sharp oozers. The anterior tibials did not bleed. All the arteries and the external saphenous vein were thrombosed. The internal saphenous vein was patent. The flaps were loosely sutured together and drainage provided. There was much suppuration in the flaps and despite energetic systemic stimulation death occurred, apparently from exhaustion, on September 20, 1909, nine weeks after the first operation. An autopsy was refused and we were forbidden to examine the seat of anastomosis.

If we omit the cases reported by San Martin and by Jaboulay where a lateral anastomosis was performed (this method having been shown to lead to failure), and that of Torrance which was done for crush, we have ten cases of arteriovenous anastomosis deliberately made in the hope of staying the progress of gangrene of the lower extremity.

In this series there were 7 males and 3 females. The ages ranged from 32 to 84 years and averaged 63 years. Senile gangrene was the term used for the disease for which the patients required relief with the exception of Wieting's case which was termed angiosclerotic gangrene and Lund's case which was probably obliterating thromboangitis.

The exact pathology of the various forms of gangrene is still rather unsettled, but it does not make any material difference whether the artery is obstructed by an obliterating endarteritis or simply by a sclerosis provided that thrombosis of the veins has not occurred. That thrombophlebitis is not an uncommon occurrence in gangrene has been shown by the excellent papers of Buerger, and if it should exist to any extent the performance of arteriovenous anastomosis would be foredoomed to failure. In my case I practised the method advocated by Buerger for ascertaining the patency of the deep veins and apparently found no impairment of their function.

Of the ten cases, one died apparently from shock (Lilienthal) 31 hours after operation. Three others died at periods varying from 8 to 16 weeks after operation Ballance, Hubbard's third, Müller) from causes mentioned above. Of the remaining six, Wieting claimed a perfect result two months after operation and Hubbard's fourth case was progressing favorably until extreme pain required amputation; these were the only two cases operated upon early. The remaining four (Hubbard's first and second, Armour and Smith, Lund) required amputation either at the "point of election" or above the knee at varying periods after the anastomosis.

"If we deflect the arterial current from the femoral artery into the femoral vein, below the termination of the long saphenous, we do so with a view to establishing the following conditions: (1) the deep veins are to be transformed into arteries; (2) the blood must find its way into the capillaries where it meets the blood from the profunda and the capillaries; and (3) a new centripetal flow must be established, primarily through a set of interanastomosing deep venules, but in the main finding its way into the vast network of superficial veins that empty in the long saphenous and thus into the femoral." (Buerger.)

There are, of course, two serious objections, theoretically, to the success of the operation: (1) the presence of valves in the popliteal vein and (2) the obstruction in the arteries tending to drive the blood from the deep to the superficial veins before the capillary system is reached. In 1903 Gallois and Pinatelle stated that according to their experiments the valves formed an insuperable obstacle to arteriovenous anastomosis, but Carrell has shown that the living tissues have great power of adaptation and that the valves are forced in a few hours, thus allowing for the reversal of the circulation.

As to the second objection the cases on record show that the blood *does* reach the tissues of the foot, but I am of the opinion that if the tibial arteries are occluded the blood barely reaches the dorsum and simply suffices to insure nourishment to the tissues at the "point of election" for amputation. It has been proposed (Buerger) that the ligation of the external saphenous would enable more arterial blood to reach the leg and foot, but it has not been performed in the cases on record. Armour and Smith ligated the internal saphenous but accomplished nothing, nor is this procedure to be recommended, as the long saphenous is needed as the efferent trunk where complete reversal of the circulation is impossible by reason of the obstructed arteries.

An objection has been raised by Ross that division of the artery and vein destroys the nervi arteriorum and that the loss of tone thus induced must favor thrombosis and that, therefore, the effect of the operation is exactly as in ligation, the collaterals supplying the blood to the tissues below. But I think it is pretty well established by the experimental work that the plexi surrounding the vessels must be to a great extent automatic in action and not dependent entirely upon impulses from the sympathetic and spinal fibres. There is undoubtedly some change in the nutrition of the vein wall and this, together with the changed conditions of pressure, results in an increase in the thickness of the wall of the vein.

Finally I would offer in conclusion:

1. That in the early stages of arterial disease producing ulcers on the toes, erythromelia, extreme pain, tingling, etc., a complete reversal of the circulation *may* relieve the condition if other measures have been tried and failed.

2. That with gangrene of a toe established, one should wait for a line of demarcation. If the process involves several toes or tends to spread to the dorsum of the foot an anastomosis between the femoral artery and vein with ligation of the external saphenous *will almost certainly* induce a line of demarcation in the region of the ankle.

3. That if the superficial and deep veins are also thrombosed the operation is useless and should not be done.

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TRANSACTIONS
OF THE
NEW YORK SURGICAL SOCIETY.

Stated Meeting, November 10, 1909.

The President, Dr. Joseph A. Blake, in the Chair.

CRANIOTOMY FOR CEREBELLAR CYST.

Dr. Charles A. Elsberg presented a man of 22 who was admitted into Mt. Sinai Hospital in May, 1909, with the history that six weeks before he had begun to suffer from occipital headache and to have attacks during which he saw double. The headache became more severe, and was accompanied by vomiting. For the past three months he had been deaf in the right ear, and his eyesight had become much impaired.

When admitted to the hospital, the patient had coarse nystagmus to the right, marked weakness of the right external rectus muscle, areflexia of the right cornea, weakness of the right facial muscles, slight weakness, ataxia and hypotonia in the right upper and lower extremities and exaggerated knee-jerks. There was marked choked disc on both sides.

During one week the symptoms became much aggravated, so that operative interference became imperative. The diagnosis of a lesion in the right cerebellar hemisphere was made, and a right suboccipital craniotomy, with removal of the bone, was performed. The right cerebellar lobe was found to contain a cyst the size of a goose egg. The cyst was opened and its contents evacuated, the cavity swabbed out with the tincture of iodine, and the dura and skin flaps sutured into place.

The patient made an uneventful recovery from the operation. When presented, he was free from all symptoms and was entirely well. His eyesight was normal, and the paralysis of the right external rectus, the areflexia of the cornea, the ataxia and weakness of the extremities on the right side had entirely disappeared.

Dr. Elsberg presented another patient upon whom he had operated for cerebellar cyst, and who was well after one year. The history of this second patient was similar to that of the first with the exception that there had been marked mental disturbance and very little optic neuritis. The left cerebellar lobe contained a small cyst which was probably due to an old hemorrhage. In this case, the operation was done in two stages: the first consisted of removal of the bone, the second of the opening of the dura, the examination of the cerebellopontine angle, the incision of the hemisphere and the evacuation of the contents of the cyst.

The patient made a very satisfactory recovery from the operation; the mental symptoms disappeared rapidly the day after the operation, and with the exception of a persisting slight ataxia in the left lower extremity, the patient was perfectly well.

HEMITHYROIDECTOMY AFTER LIGATION OF THE SUPERIOR THYROID VESSELS FOR EXOPHTHALMIC GOITRE; HYPERTHYROIDISM.

Dr. Elsberg presented a woman, 35 years old, in whom, for the relief of a severe form of Basedow's disease, he had ligated the superior thyroid vessels four months before under local anæsthesia and had sent the patient to the country for a rest. A month later the patient returned to the hospital with her symptoms unrelieved. Under ether anæsthesia, the right lobe of the thyroid was removed without difficulty. An hour after the operation the patient had a pulse of 240, with great dyspnœa and delirium. Severe symptoms of hyperthyroidism persisted for two days; they then gradually disappeared, and the patient thereafter made an uninterrupted recovery. All of her symptoms disappeared within two months: the pulse was now slow and regular, the exophthalmus had disappeared, there was no longer any tremor and the patient had gained more than thirty pounds in weight and felt perfectly well. In this case there was absence of a lymphocytosis in the blood—a condition which Kocher considered of grave prognostic significance.

HEMORRHAGE INTO THYROID CYST; HEMORRHAGE INTO OVARIAN CYST.

Dr. Elsberg presented a young woman who was admitted into Mt. Sinai Hospital with severe dyspnœa from a large swelling of the thyroid gland, of two hours duration. Under ice applications the swelling was partly reduced, and the interference with breathing overcome. The right lobe of the thyroid was exposed, and a cyst which contained a large recent blood clot was removed. The patient made an uneventful recovery, and was discharged well two weeks after the operation.

Two weeks later she was readmitted with acute abdominal symptoms of a few hours duration. At the operation, a large ovarian cyst filled with a recent blood clot was removed. The pedicle of the cyst was not twisted and looked normal. From this operation the patient also made a good recovery. Two months later she returned with similar symptoms on the opposite side of the abdomen. She refused operation and left the hospital against advice. Her symptoms gradually disappeared.

This patient, Dr. Elsberg said, had had an attack of articular rheumatism some weeks before the hemorrhage into the thyroid cyst had occurred, and the connection between rheumatism and hemorrhage into thyroid cysts was well known. It was of interest that there seemed to exist in this patient a tendency to bleeding into existing cysts. There was no other hemorrhagic tendency.

MODIFIED TALMA OPERATION FOR CIRRHOSIS OF LIVER AFTER THREE YEARS.

Dr. Ellsworth Eliot, Jr., presented a man, 55 years old, who was admitted to the Presbyterian Hospital on October 9, 1906. He had been a moderate drinker, and gave no specific history. Four years before he had symptoms of indigestion, from which he completely recovered. One year later he had a second similar attack, with loss of appetite and fever, associated with swelling of the legs and abdomen. A course of treatment with hot baths improved his condition to such an extent that he could work the following summer. Two months later his symptoms recurred, and since then he had done no work.

Eighteen months before admission his abdomen was tapped for the first time, and since then this had been repeated about twenty times, from three to six gallons of fluid being removed at each tapping, with some relief to the patient. More recently he had suffered from dyspnœa, and his general condition was not so good.

Operation by Dr. Eliot, October 16, 1906: Through an incision midway between the symphysis and umbilicus all fluid was evacuated. The thickened omentum together with the gut adjacent was then sponged off and allowed to come in contact with the wound, and after the insertion of a long cigarette drain to the bottom of the pelvis, the wound was closed.

After the operation, the patient's general condition was satisfactory. There was a very free serous discharge from the wound for ten days, when it suddenly ceased. Three weeks after the operation the ascites had recurred to a sufficient degree to give rise to a fluid wave, but this gradually disappeared in the course of a week, the patient passing large amounts of urine. During the three years that had elapsed since the operation there had been no further recurrence of fluid. The patient was able to travel and do a moderate amount of work. Eighteen months ago he returned to the hospital on account of irregular heart action and dyspnœa, and he was discharged at the end of three weeks much improved. His liver now was smaller than prior to the operation, but it still projected below the free margin of the ribs and had an irregular surface.

Dr. Eliot said he had another case, a woman, upon whom he did this operation four or five years ago, and who was still alive and able to do her housework. More recently, however, he had discarded this operation because of the rather high mortality. For a time, he thought the high death rate might be due to the use of a general anæsthetic, and he did the operation under cocaine, but the results were still unsatisfactory. For the past year he had given up the use of drainage altogether, making his incision above the umbilicus, allowing the greater part of the fluid to escape, suturing the omentum to the abdominal wall between the parietal peritoneum and the posterior sheath of the rectum and then closing the wound without drainage. With this method, his mortality was considerably less, but at the same time it had not produced so rapid a cure, for the fluid recurred, necessitating an occasional tapping, but at much longer and increasing intervals than before the operation, until finally, with the establishment of a satisfactory venous collateral circulation further recurrence ceased.

Dr. Charles N. Dowd said he had done one of these operations in a manner similar to that described by Dr. Eliot, suturing the omentum into the abdominal wall and then closing the wound. The ascitic fluid was withdrawn by tapping as it accumulated. This, however, was not necessary for a very long time, and an ultimate cure resulted.

Dr. Alexander B. Johnson said that while he agreed with Dr. Eliot that the mortality of this operation was considerable, yet the result in a certain proportion of cases was extremely gratifying. He had a woman under observation upon whom he had done the operation at least five years ago who at the time of the original operation was in a pitiable condition. He had seen this patient within the year, and during the four years that had elapsed since the operation she had never required another tapping. While the abdomen contained a small amount of fluid, the patient's general health was good; she was able to resume her household duties and she had improved to such a degree that one would scarcely have recognized her. In that case he had simply rubbed the diaphragm and liver with a nail-brush, and sutured the omentum to the abdominal wall.

In another case, a man with a marked alcoholic habit and cirrhosis, the abdominal cavity contained a large quantity of fluid and the general health of the patient was much impaired. He sutured the shriveled omentum to the undermined subcutaneous tissues of the abdominal wall and the patient recovered a fair degree of health. When he returned a year later to have an umbilical hernia operated on there was a very small amount of fluid in the abdomen. The hernia was operated on successfully and the man was still in fairly good health.

In a third case, Dr. Johnson said, he did the regular Talma operation, and during the year and a half that the patient was kept under observation there was no necessity for retapping, and the patient was able to resume his work and enjoyed very fair health.

RESULT OF OPERATION FOR HEPATOPTOSIS AFTER FIVE YEARS.

Dr. Ellsworth Eliot, Jr., presented a woman who was admitted to the Presbyterian Hospital December 7, 1903. She was then 38 years old. She had had two pregnancies, nine and seven years before. Eighteen years previously she had had an attack of severe pain in the epigastrium, with jaundice, confining her to bed for three weeks. A similar attack occurred three years before admission, with severe pain in the right hypochondrium, and vomiting. The jaundice persisted for a month. In November, 1900, a ventral fixation was performed by Dr. Eliot. At that time there was retroflexion and some menstrual difficulty, which was relieved by the operation. In April, 1903, the patient had an attack of fainting, with chills and fever, and severe pain in the back, but no vomiting nor jaundice. Since then she had had frequent attacks of fainting, with abdominal pain after eating, and occasional jaundice. For several months past she had been unable to do any heavy work.

On examination, the wall of the abdomen was soft and retracted. The lower border of the liver could be felt two inches below the free costal margin. On bimanual examination, in the right lumbar region, the right kidney could be felt to be slightly movable.

Operation: On opening the abdominal cavity, the transverse fissure of the liver was found to be in close contact with the lesser curvature of the stomach. The greater curvature was opposite the umbilicus. The right kidney enjoyed an excursion of two inches during inspiration. The gall-bladder and ducts were normal. The liver was raised a distance of two inches by suture of the round ligament, and the abdominal wound was closed after denudation of the opposed peritoneal surfaces of the diaphragm and liver.

No unusual nausea or vomiting followed the operation. The bowels moved on the third day. The pain decreased and finally disappeared, with steady improvement of the appetite. On the tenth day, slight pain in the back alone remained. The patient continued to improve, and left the hospital in excellent condition. Six months after the operation she was enjoying very good health. There was occasional pain after eating and some obscure pain low down in the pelvis, but her general condition remained greatly improved.

He had seen this patient from time to time during the past five years, and the improvement in her condition had continued, so that she had been able to do her household work and support her family. She still had occasional attacks of abdominal pain, but these were not severe, and her attacks simulating gall-stone colic had entirely disappeared.

CALCULOUS PYONEPHROSIS: NEPHRECTOMY.

Dr. Alexander B. Johnson presented a man, 51 years old, who was admitted to the New York Hospital on March 23, 1909, with the diagnosis of renal calculus and pyonephrosis of the right kidney. The case was shown to illustrate the frequent error in diagnosis made when the symptoms of a kidney lesion were referred almost entirely to the bladder and urethra.

The previous history of the patient was as follows: Twenty-five years ago he had a specific urethritis and since that time he had suffered from urinary disturbances consisting of frequent and painful micturition, with (as was alleged) occasional attacks of retention of urine. During the greater part of this time he had been treated for stricture of the urethra by gradual dilatation. For the past two years he had suffered from occasional attacks of severe pain in the right lumbar region.

During the past twenty-five years the patient's urine had been constantly loaded with pus. For the past two years the quantity of pus had greatly increased and for the past six months he had had a continued fever of a septic type, and had rapidly lost flesh and strength.

Upon admission to the hospital, the patient's general appearance was that of a man seriously ill with chronic septicæmia; his skin had an ichteroid tinge, his breath was foul, his tongue was coated, he was markedly anæmic, his urine was heavily loaded with pus and had a musty odor, with a specific gravity of 1016. It contained many colon bacilli; no tubercle bacilli.

In the right loin a tumor of considerable size was palpable; it was tender and gave the characteristic signs of an enlarged kidney. Dr. Johnson said the patient had been referred to him by Dr. Roper, the Associate Attending Physician to the New York Hospital, who had made a diagnosis of probable suppurative lesion of the kidney and had had a radiograph of the kidney region taken by Dr. Caldwell. This picture showed a large branching calculus in the right kidney.

Upon exposing the right kidney, it was found to be composed of a thin-walled sac, from which all secreting substance had disappeared. Its capsule was very tough and adherent, and during its removal it ruptured and the wound was bathed with pus. The ureter was much enlarged and dilated, but basing his action upon his experience with former cases of this character, Dr.

Johnson decided that it would not be necessary to remove more than a small portion of it.

The patient made a good convalescence, and left the hospital at the end of about thirty-three days. At that time his urine still contained a large amount of pus, which probably had its source in the remnants of the dilated ureter. As the latter contracted, the amount of pus gradually decreased, and the patient's urine to-day was almost entirely clear. His general health at present was excellent, all urinary symptoms had disappeared and examination showed that he had no stricture of the urethra.

CARCINOMA OF THE RECTUM; UNUSUAL METHOD OF ANASTOMOSIS.

DR. JOSEPH A. BLAKE presented a man 50 years old, who was admitted to the Presbyterian Hospital on May 20, 1909, suffering from adenocarcinoma of the rectum which had given symptoms of hemorrhage and partial obstruction for about seven weeks. The examination revealed a growth extending upward about three and a half inches above the anus, and therefore above the levator ani muscle.

Operation, May 25, 1909: The abdomen was opened through a median suprapubic incision eight inches long, with the patient in the Trendelenburg position. The growth was found to lie above the level of the reflexion of the peritoneum on the levator muscles, and it occupied about two inches of the length of the intestine. The superior hemorrhoidal arteries were located and tied, and the left ureter identified. About eight inches of the intestine, including the growth, was then excised, together with the retroperitoneal tissue. This was done in the following manner:

The lateral reflexions of the peritoneum having been divided, the gut with its lymphatics was loosened from its bed. Double heavy silk ligatures were then placed about the gut at the points of division, and securely tied. The gut was then divided between them with the Paquelin cautery. It was then found that the ends could be easily brought together, but that there was not sufficient room above the levator ani muscle to carry out an end-to-end anastomosis without great difficulty and soiling of the wound. Therefore, with some misgiving, the cut-off ends, including the ligatures, were stitched together, and the upper and lower segments of the gut were united about them so as to infold the closed ends. Interrupted silk sutures were used for this purpose.

This re-established the continuity of the bowel, with the exception that its lumen was closed by a double diaphragm consisting of the tied ends. The peritoneal reflexions were sutured over the intestinal anastomosis so as to exclude it from the peritoneal cavity. A stab-wound drainage, with a double rubber drainage tube, was carried up from behind and to one side of the rectum to the line of suture. A left inguinal lateral colostomy was made by suturing the sigmoid flexure into a small intermuscular wound, and introducing a tube into the intestine. The abdominal wound was then closed without drainage.

After the operation, which consumed over two hours, the patient's condition was good. At the time of the operation there was considerable doubt as to whether the ligatures tied about the end of the intestine would cut through and the continuity of the canal be re-established. If this did not occur, it was Dr. Blake's intention to break through from below at a later date, when the wound surface had commenced to granulate and infection would therefore be limited. This was found to be unnecessary, as the ligatures and part of the suture line gave way, so that the fæces began to come through both the drainage wound behind the rectum and through the anus itself on the fourth day. At first there was as much fecal discharge from the drainage wound as there was from the anus, but the former gradually closed and in four weeks' time the entire fæces escaped through the normal passages. The colostomy wound closed of itself.

The patient was discharged from the hospital on July 3, 1909, with normal defecations. There was a postoperative rise of temperature to 101.5, and a return to normal on the sixth day. After that there was a more or less continued temperature from infection of the perirectal tissues, but this gradually subsided.

The histological examination of the growth showed it to be an adenocarcinoma.

At the present time, nearly six months after the operation, there is only a slight narrowing of the calibre of the intestine at the point of anastomosis.

In discussing this case, Dr. Blake said it probably would have been better if a complete colostomy had been done, so that the fecal current would have been entirely diverted from the lower bowel. Healing would then probably have proceeded with less infection.

EXCISION OF THE RECTUM FOR CANCER BY THE PERINEAL ROUTE.

DR. CHARLES H. PECK read a paper with the above title, for which see page 242.

In connection with his paper, Dr. Peck presented two patients upon whom he had operated by this method.

DR. ARPAD G. GERSTER said he thought the most notable feature of the operation described by Dr. Peck was to leave the gut closed after the proximal end had been stitched into the sphincter. This had been found very useful to prevent early infection of the wound, which was most to be feared in the after-treatment.

DR. FREDERIC KAMMERER said that during the past few years he had practically abandoned the operation of resection of the rectum. In his experience, he had only had one case of resection without a preliminary artificial anus in which primary union had occurred throughout. Generally, the sutures gave way at the posterior border of the bowel, where there was no peritoneal covering, and these posterior fistulæ were not so easy to close as one would be led to believe from a perusal of the literature on the subject. As a matter of fact, the correction of deformities resulting from infection and the separation of sutures in amputations as well as resections of the rectum was one of the most difficult problems of plastic surgery. Of course, such mishaps could be to a great extent avoided by establishing a preliminary artificial anus, which, however, condemned the patient to three distinct surgical procedures, a point worthy of consideration.

Dr. Kammerer was furthermore inclined to believe that recurrences were more frequent after resection than after excisions. Considering everything, the best results could be obtained, in his opinion, by the establishing of a permanent inguinal anus and the excision of the rectum, the question being simply how that was best accomplished. He had, during the past five or six years, established a permanent inguinal anus in every case of cancer of the rectum, even of the third uppermost portion. If it appeared necessary, a digital exploration of the pelvis, to determine the question of a possible radical operation and the presence of secondary deposits higher in the bowel, might be made at this time, an advantage claimed for the first step of the combined operation. After two or three weeks the tumor was then removed by the posterior or sacral route, the lower portion of the bowel having been meanwhile irrigated with normal salt solution several times a day. The change that would very often occur, not alone in the condition of the patient, but also in the size and mobility of the tumor under this treatment was a point not sufficiently insisted on in late surgical literature.

The objections generally raised against preliminary colostomy were the three operations, as against one in the case of a temporary anus, and the fixation of the loop in the inguinal region, preventing a drawing down of the upper end of the bowel to the anus or sacrum after removal of the tumor. The first of these objections has fallen with the permanency of the artificial anus, and as to the second, Dr. Kammerer's experience had taught him that it was much exaggerated. However, in doing a secondary excision it is only necessary to close the stump of the rectum with sutures and to attach it to the incised peritoneum of Douglas' pouch. There is no occasion for an approximation of the stump to the original anal orifice.

This procedure may not be as brilliant as the combined operation in one sitting, but it is an eminently safe operation with a very low mortality, indeed, and it accomplishes practically the same thing. The small stump of the sigmoid that remains had never proved a source of annoyance in the speaker's cases. As a matter of fact, an exploration of the pelvis later on was possible through this opening, when the natural anus is missing.

Dr. L. W. Hotchkiss said that in two of his cases where he brought down the divided segment of the gut through the anus with excision of the mucosa, sloughing occurred at the posterior point of union, as it usually did. In both instances, however, the wound had healed by granulation. In one of these cases seven years had now elapsed without any recurrence, and in this case there was originally a small stricture, which was easily dilated by means of bougies and gave no further trouble.

Dr. Hotchkiss said that if it was possible to secure union between the cut ends of the gut above the sphincter, without complete division through the sphincter, the functional results were generally very much better.

Dr. John A. Hartwell said he wished to emphasize the importance of the points brought out by Dr. Kammerer. Three or four years ago he read a paper on this subject before the New York Surgical Society in which he reported about fifty cases of cancer of the rectum collected from the work of seventeen different surgeons, and of that number of cases the cures after three years were less than 20 per cent. The recurrences were practically all local. In most of the cases that had been reported at the present meeting, the time that had elapsed since the operation was too short, though the primary results were most satisfactory. Personally, he was in favor of a preliminary colostomy, in order to get the patient into the best possible condition, and he was opposed to cutting too close to the malignant growth. In these operations, in considering the immediate comfort of the patient, we should not lose sight of the ultimate outcome. Excision of the whole rectum for any growth that can be reached with the finger from the anus is better than resection and anastomosis.

Dr. Blake said he had come to the conclusion that the better operation was to excise the entire growth with the end of the bowel. His own procedure had been to establish an artificial anus at the time of the operation. He had operated on twelve or fourteen cases by this method, without mortality. In the case he had shown at this meeting, Dr. Blake said, the patient had told him that there was a slight narrowing at the point of junction, and it was possible that a stricture would develop later on.

Dr. Hotchkiss said the point had been raised in regard to bringing down the sigmoid, whether the operation was done by the high or low method. The old method of skinning back the peritoneal investment was apt to give rise to necrosis and the same was true if the mesocolon was ligated too close to the bowel. The further back from the gut the ligature was placed, the less tendency there was to necrosis.

Dr. Peck, in closing, said he had had one rather disastrous result in a combined operation, in attempting to tie the vessels some distance back, near their origin, in the hope that the circulation would be established in the gut below through the loops. Having been rather impressed with the favorable reports of that method, he ligated the vessels close back to their origin. The result at first seemed to be satisfactory, but death from necrosis occurred six days after the operation. That case, he thought could have been saved by an operation from below, or by establishing a permanent inguinal anus. That experience had discouraged him from further trials of that method, which was advocated by Moynihan.

In regard to splitting the sphincter posteriorly, he favored that method because it gave a rather free exposure and afforded a better opportunity for excising the mucous membrane.

Stated Meeting, November 24, 1909.

The President, Dr. Ellsworth Eliot, Jr., in the Chair.

CHOLECYSTECTOMY FOR CHOLELITHIASIS.

Dr. Alexander B. Johnson presented a man, 34 years old, who was taken sick two weeks prior to his admission to the New York Hospital with a dull, aching pain in the right hypochondrium. It shifted for a short time to the epigastrium, but soon reverted to the first location, where it had persisted. He had vomited once with the onset of the pain. There was no history of jaundice; no definite chill nor sweating.

Upon examination, there was slight rigidity and the sensation of a rounded, smooth mass, about as large as a mediun sized orange, in the right hypochondrium. The mass, which was not very tender, seemed to extend about two inches below the free margin of the ribs, just below the position of the gall-bladder. The abdomen was otherwise normal, and there was no rigidity outside of this area.

On October 18, 1909, the gall-bladder was exposed through an incision three inches in length. It was then found that the mass was composed largely of adherent omentum, which was in a condition of inflammatory infiltration. Upon separating the adhesions, the gall-bladder was found to be much enlarged; it was necrotic in spots and almost ready to perforate. Upon aspiration, its contents were found to be purulent. The pedicle of the gall-bladder was then clamped, and the sac removed *in toto*. The orifice of the cystic duct was sutured to a piece of rubber tubing which was left for drainage, and the wound was then closed.

The patient made a good convalescence, although he still had a biliary fistula which was rapidly closing. Drainage of the cystic duct was continued for nine days, and there were no further evidences of infection of the biliary passages. The wound healed by primary union throughout and the patient was now in good condition. The excised gall-bladder was found to contain about 163 stones, nearly all of the same size and shape; *i.e.*, imperfect cubes, the sides one-third inch in length.

FRACTURE OF THE ANATOMICAL NECK OF THE HUMERUS, WITH DISLOCATION OF THE HEAD INTO THE AXILLA.

Dr. Johnson also presented a woman, 63 years old, the widow of a physician, who four weeks prior to her admission to the New York Hospital fell in alighting from a railway coach, a distance of about 2½ feet. She struck upon her left shoulder, side and hip. Upon rising, she noticed that her left arm, aside from paining her very severely, was fixed in a slightly abducted position. She consulted a physician, who manipulated the arm and succeeded in getting it adducted, although he heard no click as if the head of the bone had slipped back into the glenoid cavity. Three weeks later the arm was again manipulated for diagnostic purposes, without any result.

When Dr. Johnson first saw the patient, the arm was fixed in a fairly normal position. There was a slight forward axial deviation of the shaft of the humerus. There was no inward displacement of the upper extremity of the shaft; no crepitus nor false point of motion. On passive rotation the tuberosities moved with the shaft. The head of the bone was felt in the axilla. Two X-ray pictures were taken, which established the diagnosis of a fracture through the anatomical neck of the humerus, with dislocation of the head into the axilla.

An operation for the removal of the dislocated head was done eleven days ago by Dr. Johnson, and considering the brief time that had elapsed, the result was very satisfactory. The dislodged head of the bone was approached by a curved incision through the pectoralis major muscle. This exposed the brachial plexus and the axillary vessels, which had to be drawn inward before the bone could be seized and extracted with the lion-jawed forceps. An axillary drain was inserted, which was removed on the second day, and the wound healed in five days. The intense pressure pain from which the patient had suffered was immediately relieved by the operation, although she still complained of some tingling in the distribution of the ulnar nerve. There was no actual anæsthesia nor definite loss of power.

Dr. Johnson said he hoped that with time and use and under suitable local treatment, the loss of function entailed by the injury would be greatly diminished. So far as he had been able to learn less than 40 of these cases were reported in surgical literature in which the diagnosis had been verified by operation, and the total number, whether verified or not, was under 50.

Dr. Ellsworth Eliot, Jr., said he had seen two cases of fracture of the anatomical neck of the humerus, with dislocation of the head into the axilla. One of them, which he still had clearly in mind, was operated on three months after the accident. The head of the bone was in the same position as that in the case shown by Dr. Johnson, and over it was stretched the neurovascular sheath. The glenoid cavity was filled with reparative material. The head of the bone was removed, and three years later the movements of the affected arm were equal to those on the opposite side. In this case the pointed extremity of the lower fragment was brought into apposition with the partly obliterated glenoid cavity, and this had evidently established a satisfactory joint. In his second case, Dr. Eliot said, the head of the bone was also removed, and when the patient left the hospital there was a considerable range of motion, especially of abduction, which was the most difficult movement to recover.

CYST OF THYROGLOSSAL DUCT.

Dr. Alfred S. Taylor presented a man of 40 years who for three years had had a cyst just above the larynx which gradually became more annoying, so that he asked to have it removed. The operation for this purpose was done on June 18, 1909. A transverse incision was made over the cyst, which extended from the upper border of the larynx to the under surface of the hyoid bone. From this point a small fistulous opening penetrated the hyoid bone and extended to the base of the tongue. The cystic growth was shaped somewhat like an Indian club above the hyoid and ran up to the dorsal surface of the tongue. The cyst below the hyoid had pushed the thyrohyoid membrane backwards until it almost touched the posterior wall of the pharynx. Although the patient is a singer this had not interfered with his voice. The cyst was entirely removed, no drainage was used, and primary union resulted. The scar can now scarcely be found.

Dr. Eliot said that in young people, particularly, it was quite possible to remove that portion of the cystic tract that penetrated the hyoid bone, as in the case shown by Dr. Taylor. In one case that came under his observation in a child of six or seven years, the hyoid bone was easily divided, and the cyst in its centre was removed. The portion of the cyst behind the bone was then readily removed, and at the completion of the operation the divided hyoid bone was sutured, rapid union taking place, with complete restoration of function. The speaker said he did not know whether after a similar procedure in an adult union could always be relied upon.

PERFORATING DIVERTICULUM OF ASCENDING COLON.

Dr. John A. Hartwell presented a woman, 43 years old, who was admitted to the Presbyterian Hospital on August 30, 1909. For the past ten years the patient had suffered from attacks of abdominal pain coming on at night, which were usually relieved by vomiting. The pain was general in character, but more severe in the epigastrium. It recurred two or three times yearly. Two years ago she had her first attack in which the pain was localized in the right lumbar quadrant; this was accompanied by fever and vomiting and lasted one week. Since then she had had similar attacks every three or four months. She was constipated. Blood had never been noticed in the stools.

The patient, upon her admission to the hospital, was fairly nourished, and her general appearance was good. Examination of the abdomen revealed a mass in the right lumbar quadrant; this was hard, and firmly adherent to the border of the ileum. The vagina and uterus were somewhat fixed posteriorly, and there was tenderness in both quadrants.

Operation, September 12, 1909: After a preliminary curettage of the uterus, Dr. Hartwell made a midsuprapubic incision. The uterus was found to be fixed posteriorly by recent adhesions; there were small cysts in each ovary, and a larger one, about the size of a walnut, in the left broad ligament. The cysts were removed, and the uterus lightly suspended. An intermuscular incision was then made over the mass, which was found to consist of the appendix turned up outside and behind the cæcum and colon, and buried in adhesions. The appendix was greatly thickened, but not acutely inflamed. Its tip was buried in a thickened, hard mass in the wall of the colon, just anterior to the outer half of the mesentery, and when it was dug out the mass was found to have a perforation large enough to admit a probe, which communicated with the lumen of the bowel.

The appendix was removed, and the thickened area in the wall of the colon, about an inch and a half in diameter, was excised and the opening closed with three layers of sutures. The abdominal wall was then closed in layers, with drainage. The patient made an uneventful recovery from the operation, and left the hospital in four weeks, a small fecal fistula having remained opened for about two weeks.

The pathologist's report showed that the specimen removed consisted of the appendix and two sections of the wall of the cæcum, both of which were considerably thickened. In one of the sections there was a small saccule, 8 mm. in diameter, lined with mucous membrane, which appeared to have been pushed through the muscularis. A small perforation was found in the blind end of the saccule. Microscopically, the sections showed a small sac lined with normal intestinal mucosa which was thrown up into small folds. The wall of the sac was composed of fibrous tissue, densely infiltrated with polymorphonuclear leucocytes and lymphoid cells. No muscular coat remained in the wall. Its point of termination on either side of the sac was sharply defined. The terminal muscle fibres showed signs of atrophy, and were being replaced by fibrous tissue.

Diagnosis: Acute suppurative diverticulitis, with chronic appendicitis and typhlitis.

The case showed two points of special interest: first, the absence of the causes usually considered operative in diverticular development, advanced age, excessive fat or excessive emaciation; and second, the locations of the disease in cæcum or the ascending colon instead of the descending colon or sigmoid.

SIGNIFICANCE OF THYROIDISM.

Dr. John Rogers read a paper on the above subject, for which see page 145.

In connection with his paper, Dr. Rogers showed a number of patients which illustrated the various types of thyroid enlargement.

Dr. Rogers, in reply to a question, said that patients who were suffering from thyroidism usually took ether badly and were poor subjects for operation. When an operation on them was necessary, he thought it should be done under nitrous oxide anæsthesia.

In reply to Dr. Moschowitz as to how he explained the exophthalmus in these patients, Dr. Rogers said he could not explain it. He regarded that as the most obscure feature of the symptom-complex.

Dr. Eliot said he recently saw in consultation a patient aged 40 years, with thyroid enlargement of six years' standing, who had been operated on for chronic appendicitis. Ether was used; the operation lasted less than an hour. At its completion the patient failed to regain consciousness and developed alternate delirium and stupor. The pulse ranged about 80 for six hours and then rose to 120 or 130. The delirium became more violent, requiring the use of morphine to control it. The temperature gradually rose, and the patient died fifty-six hours after operation, without having regained consciousness. He asked whether the symptoms in such a case could be ascribed to acute thyroidism? This patient had an exophthalmic goitre in a quiescent condition, a moderate acceleration of the pulse being the only symptom associated with a slight increase in the size of the gland, which was readily controlled by weekly applications of the Faradic current.

Dr. Rogers replied that in the case mentioned by Dr. Eliot there was undoubtedly an acute toxæmia from the effect produced by the ether, probably on the liver. The speaker said he had heard of several similar cases. No remedy for the condition had been suggested.

TUBERCULOSIS OF THE KIDNEY.

Dr. Alex. B. Johnson showed a tubercular kidney with numerous submaxillary tubercles in the cortex and a large superficial tubercular ulcer in the pelvis. Tubercle bacilli were found in the urine before the operation. The lesion was a very recent and acute one. He had never seen a specimen of a tuberculous kidney removed at so early a stage of the disease.

TRANSACTIONS
OF THE
PHILADELPHIA ACADEMY OF SURGERY.

Stated Meeting, November 1, 1909.

The President, Dr. William J. Taylor, in the Chair.

BULLET WOUNDS OF THE CHEST, INVOLVING THE LUNG.

Dr. James A. Kelly reported the histories of three cases of bullet wounds of the chest, involving the lung, which had recovered after thoracotomy.

Case I.—*Bullet wound of lung: Hæmothorax resulting in empyæma: Thoracotomy with resection of eighth rib sixteen days after injury.*—A man, aged 21 years, was admitted to St. Mary's Hospital, September 6, 1907, with this history: While in the act of robbing a freight car he was detected, and while running away was shot in the back, about 12.30 a.m. by an officer. He was admitted to the hospital about one-half hour later. Patient stated that after being shot he was able to walk about one square when he became faint and fell to the ground.

When admitted he was in a state of marked collapse—pale, covered with a cold perspiration, extremities cold, voice weak, markedly dyspnœic. Temperature 94, pulse 140, and respirations 36. When seen about one hour after admission patient was in a state of extreme shock, and symptoms presented were about the same as on admission. Examination of the chest showed an irregular punctured wound about 1½ to 2 inches below the lower angle of the left scapula. Anteriorly, above and at the junction of the third rib and the costal cartilage there could be felt a small hard mass which was apparently the bullet. This could be felt just beneath the skin. Examination of the left lung showed the presence of moist râles at the apex, and an area of dulness extending upward to the sixth rib posteriorly. Marked cellular emphysema of anterior and lateral aspects of the left chest wall. On account of the patient's condition operative interference was not considered. He was given morph. sulph. gr. ¼ hypodermatically and an ice bag was placed over the left chest. From this time the case was treated expectantly, as he had reacted considerably by 8 o'clock the morning of admission. The temperature was then 100 $^4/_5$ degrees, pulse 160, and respirations 46.

During the first week the temperature was elevated, ranging from 101 $^2/_5$ to 99 $^1/_5$, the average temperature being about 101 degrees; at the end of seven days it reached normal once and then varied between normal and 102, until the end of the sixteenth day. The pulse varied between 160 and 104, averaging about 130. The respirations varied between 46 and 24, averaging about 36. The patient did well during the first week, but during the second week his general condition did not improve as well as was expected, so that on the fifteenth day an exploratory puncture was made and a syringeful of bloody purulent fluid was obtained. Physical examination of the left chest at this time showed dulness reaching posteriorly to the second rib, and extending into the axilla. Pulmonary resonance was absent over this area, and above there were diminished breath sounds, and coarse moist râles.

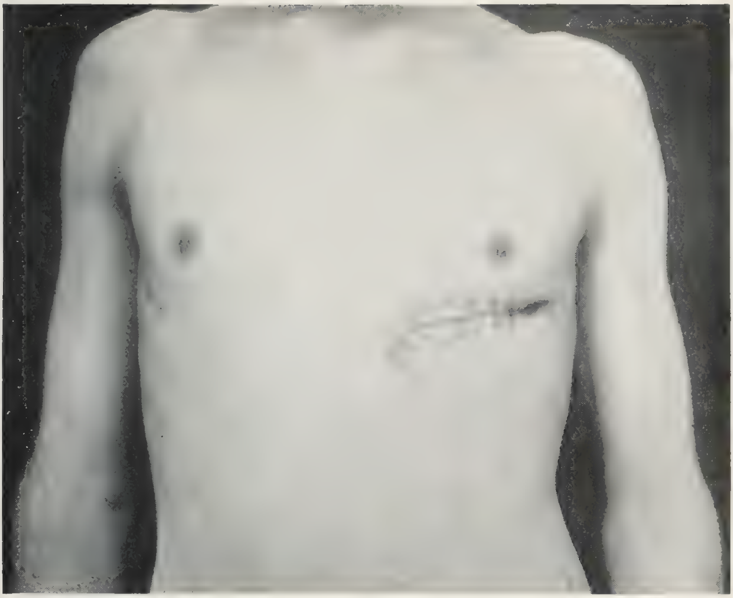
Operation.—Sixteenth day: Ether anæsthesia. Thoracotomy with resection of eighth rib in posterior axillary line. On opening the pleural cavity a large quantity of bloody purulent fluid escaped, a rough estimate being between a pint and a quart. Examination of the pleural cavity showed the lung to be almost collapsed excepting where it was connected to the parietal pleura by soft adhesions. These latter were separated as well as possible and a double rubber drainage-tube introduced. The bullet was then removed through an anterior incision made over its position of lodgement. The bullet was of .38 calibre. The patient reacted well from the operation and the temperature reached normal at the end of the ninth day. At the end of two weeks the patient was out of bed, and he was discharged from the hospital with the fistula completely closed January 28, 1908, four months and three weeks after the injury.

Case II.—*Bullet wound of lung: Thoracotomy and resection of rib about four hours later: Artificial pneumothorax: Recovery.* A man, aged 23 years, was admitted to St. Mary's Hospital, September 11, 1909, soon after having shot himself with a revolver (.22 calibre). He was seen by the reporter about 3 to 4 hours after injury. He was then markedly collapsed, pale, skin covered with a cold, clammy perspiration, temperature $98\,{}^{3}/_{5}$, pulse 104, respiration 48. Examination of chest shows a small punctured wound, with blackened edges, over the sixth rib, about one inch outside the nipple line. No wound of exit seen, and location of bullet can not be determined. Percussion of left chest shows an area of dulness posteriorly from third rib downward extending into the axilla. Above this area of dulness there is normal resonance; breath sounds are normal excepting for some fine friction sounds. Patient has not coughed up any blood. On account of the patient's general condition and the apparent progressive nature of the symptoms it is decided to explore the pleural cavity and control the bleeding.

Operation: Chloroform anæsthesia. The track of the bullet was followed and it was found to have penetrated the sixth rib. The incision was then enlarged and the sixth rib resected from the costochondral junction posteriorly for a distance of about five to six inches. The pleural cavity was then opened, and was found to contain about one quart of blood and active bleeding from a punctured wound of the lung which was situated about two inches from the free margin and in the lower lobe. A wound of exit in the lung and also a wound of the posterior pleura corresponding to it was present. The blood in the pleural cavity was evacuated by means of dry gauze sponges and it was found by this time that the bleeding had ceased from the lung, which was collapsed. The pleural cavity was then closed with layer sutures except at a point posteriorly, where a double rubber tube was placed for drainage. The patient was returned to the ward in good condition.

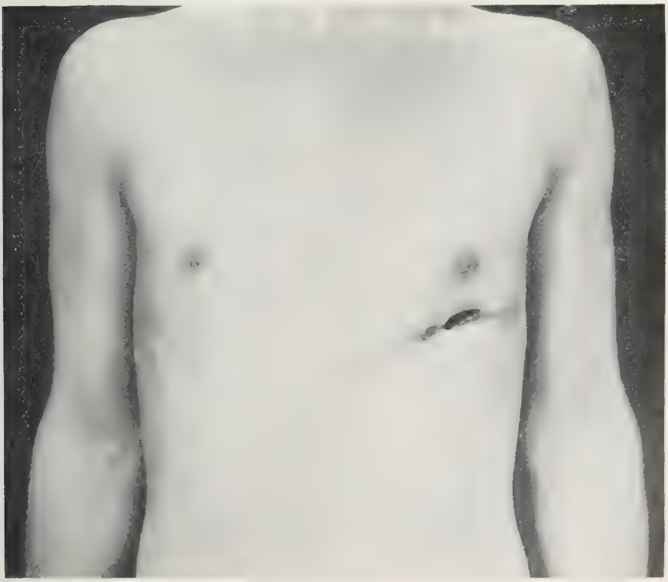
Postoperative history: The postoperative temperature rose to 100 degrees, the pulse dropped to 30, and the respirations were 34. At 9 A.M. on the second day the temperature fell to 99 degrees, the respirations were 24, and the pulse 140. The temperature remained about 100 degrees, pulse 110, and respiration 28 on the third day. On the fourth day the temperature was $101{}^{4}/_{5}$ degrees, which fell on the fifth day to $99{}^{3}/_{5}$ degrees. For the remainder of the week the temperature varied between 99 and 101 dgrees. During the second week the temperature fell to normal and the patient was allowed to sit up in a chair. During the third week the discharge, which had been serofibrinous,

FIG. 1.



Case II.—Photograph taken on the forty-fifth day after injury, showing wound entirely healed excepting for drainage wound at its posterior end.

FIG. 2.



Case III.—Photograph taken on the thirty-eighth day after injury, showing wound entirely healed except at point of drainage at centre.

decreased in amount and the rubber drainage-tube was discontinued, but in a few days was reintroduced and a large collection of pus (about 14 oz.) was evacuated. Since then the patient has rapidly convalesced; the amount of discharge has rapidly decreased, the lung has expanded so that at present there is a small cavity which contains about 2 ounces of seropurulent fluid (Fig. 1).

CASE III.—*Bullet wound of lung: Thoracotomy with resection of sixth rib one hour later: Sutures of two wounds of lung: Recovery.*—A man, aged 38 years, was admitted to St. Mary's Hospital, September 22, 1909. While suffering from delusions and mental depression the patient had shot himself in the left side of the chest with a revolver of .38 calibre. He was admitted to the hospital about one-half hour after injury, at 5 P.M.

On admission he was pale and anxious. There was marked respiratory difficulty, so that he could only breathe with difficulty when in the recumbent posture. Temperature on admission 99 degrees, pulse 164, respiration 36. Physical examination shows a bullet wound having a large ragged wound of entrance with blackened edges in the left nipple line and sixth interspace. With each inspiration and expiration there is a stream of blood ejected from the wound, which is large enough to admit the tip of the index finger. Examination of the left lung shows all the signs of collapse, with the presence of fluid at the base. As patient's condition was becoming progressively worse an exploratory thoractomy was decided upon to control the hemorrhage.

Operation: Chloroform anæsthesia, one and a half hours after injury. Exploration of the wound with the finger showed it to be continuous with the pleural cavity. A transverse incision was then made from the costochondral junction over the sixth rib to anterior axillary line, and the sixth rib resected for a distance of about 5 to 6 inches, and the pleural cavity opened. Exploration of the pleural cavity showed the presence of a large amount of fluid blood, a collapsed lung, and two wounds of the latter—one of the lower lobe about one inch from the free border, and one of the lower and outer portion of the upper lobe near its lower edge. Wounds of exit were present in both lobes. The wounds were large, measuring about 3 cm. long and 1 cm. in width. Both wounds were bleeding very actively. The blood in the pleural cavity was removed with dry gauze sponges and then each lobe of the lung was seized with a flat wide-bladed forceps, separately drawn into the wound and the bleeding controlled by means of interrupted No. 1 catgut sutures. The track of the bullet in the chest wall was excised, and the wound of the chest wall closed with layered sutures of catgut and silkworm gut, excepting at the posterior end where a double rubber-tube was placed for drainage. The patient was returned to the ward in a condition of shock, which lasted for several hours.

Postoperative history: At 12.30 A.M., about six hours after the operation, the temperature rose to $100^2/_5$ degrees, and at six o'clock the temperature was $99^3/_5$ degrees. The pulse rate fell from its maximum of 164 to 130 shortly after the operation; six hours after it was 120, and the next morning it was 100. The respirations fell to 24 after the operation, and were 36 next morning. During the first week the temperature varied from $99^2/_5$ to $102^4/_5$ degrees. The discharge from the wound was at first bloody, but at the end of the week it had become serofibrinous. During the second week the temperature varied from 99 to $101^4/_5$ degrees; the pulse rate varied from 102 to 90 in the evenings and from 94 to 78 in the mornings, and the respirations varied from 30 to 18. During the third week the patient sat up in a chair and the temperature reached normal. The discharge from the wound became purulent and rather profuse in amount. Since this time the patient has been progressing very favorably. The wound still discharges a small amount of purulent fluid and there is a small cavity containing about 2 ounces of pus. The lung has expanded well and the patient is gradually becoming much stronger (Fig. 2).

Dr. Kelly remarked that bullet wounds of the chest wall involving the lung may be divided into two classes: (1) those in which there is evidence of a hæmothorax or a pneumothorax, but the symptoms of shock and hemorrhage are not severe or progressive in character, and (2) those in which the symptoms of shock and hemorrhage, and especially the latter, are progressive in character. In the first class immediate operative interference is not indicated, but one should delay, and future operative interference should not be considered unless there is evidence of non-absorption of the blood in the pleural cavity, or the hæmothorax has become an empyema. An operation to recover the bullet is not considered advisable unless it is superficial in position, and then only after the signs of shock have entirely disappeared. In the second class of cases immediate operative interference is considered advisable (1) when the symptoms of shock and hemorrhage are progressive in character, (2) when there is evidence of active hemorrhage combined with a pneumothorax (the presence of active bleeding from a bullet wound combined with a pneumothorax shows that the collapse of the lung has not controlled the bleeding), (3) when there is evidence of increased bleeding operative interference may control it by the production of a pneumothorax, and if the bleeding is not controlled in this manner, direct suture of the lung tissue may readily be performed.

While the opening of the thoracic cavity under positive or negative pressure would facilitate the localizing of the seat of the hemorrhage and lessen the amount of operative shock, yet at the same time it would in all probability have increased the hemorrhage.

While the last two cases were drained the reporter would be inclined to close up the wound in the chest wall without drainage, provided the wound of entrance could be thoroughly excised and the bullet removed.

Dr. John H. Jopson said that very few cases of control of pulmonary hemorrhage by suture are on record. In 1908 Kuttner was able to collect but 6 cases of suture of the lung for gunshot wounds and nine cases of the lung for stab wound, with 6 recoveries. These cases were all reported from the foreign literature. Several years ago Dr. Jopson reported one case of suture of the lung before the Academy for stab wound, which terminated in recovery. It is undoubtedly true that in a number of cases simply opening the chest and establishing a pneumothorax seems to control hemorrhage, but this does not always suffice. In one case of gunshot wound of the lung on which he operated the exploration was undertaken with the idea that the heart had been wounded; the bullet had entered in the third interspace an inch and a half to the left of the sternum, and the symptoms were those of pericardial distention and interference with the heart action. In that case he turned in a quadrilateral flap and had the same experience as had Dr. Kelly in one of his cases, the production of a pneumothorax sufficient to result in the control of the hemorrhage. A laparotomy pad was inserted into the pleural cavity to control active hemorrhage during the stage when the patient's condition was most alarming, and the withdrawal of the pad was followed by arrest of hemorrhage, and he closed the wound immediately. The patient died of delirium tremens on the fourth day without any return of the hemorrhage. In the case of suture of the lung referred to, the hemorrhage was not entirely controlled by primary exploration and pneumothorax, and a running stitch of catgut to the wound on the edge of the large lobe of the lung was necessary for its complete control. In every case where drainage has been instituted it has been his experience that there has been some infection of the pleura, and this experience has been borne out by the experimental studies of Nötzel, showing the great susceptibility of the pleura to infection where pneumothorax is present. This is not a contra-indication to drainage, because where good drainage is instituted the infection is usually rapidly thrown off. In cases of doubt drainage should be instituted.

Dr. John H. Gibbon said that one of the difficult questions in the treatment of gunshot wounds of the chest is to decide which case should be operated upon and which should be left alone. In most of the gunshot wounds of the lung from small calibre bullets, although the condition may be alarming at first, the hemorrhage usually ceases and the patient recovers. That is one reason surgeons should be careful in the selection of cases. Another is the point that after an operation drainage is necessary, and that whenever drainage is instituted practically always there is infection. These cases reported by Dr. Kelly are rather good illustrations of those in which operation should be undertaken. He thought, however, that a mistake has been made much more often in operating upon cases of gunshot wound of the lung than in not operating. A great many of these cases which look hopeless for a while get well; some develop an empyema later and have to be operated upon, but his own idea is not to operate unless they show such symptoms as those displayed by Dr. Kelly's second case. Stab wounds are more apt to require operative interference than gunshot wounds with small calibre bullets. Gunshot wounds received on the battlefield do not require operation so frequently as do those in civil life.

Dr. Robert G. Le Conte said that the question of drainage in these cases is not always an easy one to decide. He agreed with Dr. Jopson that drainage is apt to be followed by some infection, but whether the infection is due to the drainage *per se*, or to material which has already been carried into the pleura by the primary injury, is a question. When the wound is clean, as it frequently is in a knife-cut, he would have no more fear of draining the pleura than of draining the peritoneum. It is to be remembered that there are two sources from which infection can take place besides the drainage track: externally from material carried in at the time of the injury, and internally, by the opening of a bronchus. Should infection take place from either of these sources, drainage of the pleural cavity will certainly limit the extent of the pyothorax. When the pleural cavity is clean at the time of operation, there is small chance of infection taking place through the drainage track when properly safeguarded. In the majority of cases the bleeding from the lung will be controlled by the admission of air to the pleural cavity and collapse of the lung, in both gunshot and stab wounds. In his limited experience he had not yet had to suture the lung to control bleeding.

Dr. Francis T. Stewart said that his own rule in these cases is somewhat as follows: If he feels sure that the lung alone has been injured, either by gunshot or stab wound, he does not operate unless the wound is near the root of the lung. Hemorrhage from the lung itself almost invariably controls itself, particularly if some air is allowed to get into the thoracic cavity. He had seen a good many cases in which he had not operated and which had done well. He had explored a number of cases, however, because he thought the heart was injured or that the diaphragm was penetrated. If there is any question of a wound of the heart or penetration of the diaphragm, or injury of the large vessels, exploration should be carried out and hemorrhage controlled. If the parenchymatous tissue of the lung alone is wounded the bleeding usually ceases of its own accord or as the result of collapse of the lung and pneumothorax. There may be cases of large wounds of the lung which will die from hemorrhage alone, and perhaps in some of these cases suture or packing would be indicated.

Dr. John B. Roberts said that one of the interesting features of these cases was the greater rapidity in the cure of the operative cases than in the cases which were allowed to go on until an empyema occurred. He agreed with several of those who had spoken, that gunshot wounds of the lung are frequently cured without operation,—yet he felt that the cases just reported seem to have recovered more quickly than if they had not been promptly opened. He had found in some of these cases which do badly from acute traumatic pneumonia that a prompt phlebotomy has been of service.

Dr. J. E. Sweet said that certain experimental observations had suggested to him a possible mode of infection after wounds of the chest, which might have some decisive bearing upon the question of drainage. The phagocytes can take up bacteria from the alveoli and possibly the bronchioles of the lung; such phagocytosed organisms are not immediately killed in the body of the leucocyte. These phagocytes normally wander to the spleen or bone marrow, perhaps; but an irritation of the pleura might attract them to the wound and the organisms becoming free, an infection could result.

ARTERIOVENOUS ANASTOMOSIS FOR GANGRENE OF FOOT.

Dr. George P. Müller read a paper with the above title, for which see page 246.

Dr. J. E. Sweet said the fact of the previous operation in Dr. Müller's first case leaves little opportunity for discussion; the operation chosen was the only surgical possibility. Had it not been for the first operation, the use of formalinized arteries would have come into the discussion. They had been surprised in the laboratory to note the slight reaction caused in the substance of the brain by an artery hardened in formalin. The suggestion to use such material in aneurysms seems practical, but he did not know of its having been tried.

It sometimes seems as if the workers with human material were somewhat slow to adopt the suggestions of the laboratory. Possibly Dr. Müller's second case is an example of the reason why the laboratory suggestions are not more readily adopted, they are not always practical, as in the suggestion of the transposition of the circulation for gangrene which is hardly practicable. If the course of an artery to its capillaries is followed it will be found that the blood gradually becomes venous from the processes of anabolism and katabolism; in other words, the capillaries, upon which the life of the tissue depends, are half venous, half arterial. If the blood will not pass through the arterial half of the capillary, when pursuing its normal course, one fails to see how it can if led to the capillary from the venous side.

Dr. George P. Müller added that it does not seem feasible, physiologically, to effect reversal of the circulation, but Carrell reports having done so in dogs. Of course if the artery is thrombosed it is impossible to effect the reversal, as the blood must leak through the large veins which unite the deep and superficial venous vessels, and therefore fail to reach the foot. It is impossible, if gangrene is once established, to send sufficient blood to the foot to prevent gangrene from spreading beyond the toes, but he believed it to be possible almost always to obtain sufficient circulation to enable the amputation to be done in the leg.

MALIGNANT DEGENERATION OF BENIGN DISEASE OF THE BREAST.

Dr. John Speese read a paper with the above title for which see page 212.

Dr. William L. Rodman said that it is beginning to be appreciated that all benign tumors in every part of the body are liable to malignant degeneration, and that this is more likely to occur in the breast than elsewhere, on account of the fact that the soil of the mammary gland is fertile to cancer. He did not, however, think it to be appreciated as sufficiently as it ought to be that the danger of any benign tumor undergoing malignant change sooner or later, is as great as it is; as Dr. Speese had said. there are certain varieties of neoplasms more prone to undergo carcinomatous change than others. The papillary cyst adenoma he should consider the most likely to undergo malignant change. In the first place it is with difficulty differentiated from malignant disease; so is involution mastitis. Papillary cyst adenoma is, however, more likely to involve the central part of the gland and to be just behind the areola; whereas involution mastitis particularly is more likely to involve the periphery of the gland. There would be more difficulty in differentiating between papillary cyst adenoma and involution mastitis than between papillary cyst adenoma and carcinoma. The age of the patient is also a help. Papillary cyst adenoma is usually more apt to occur about 50, and there is very little pain, whereas there is much pain in involution mastitis. There is, however, such a similarity regarding age in these various conditions, that the only safe way of making a diagnosis is by an exploratory incision, which should only be done after the consent of the patient has been obtained for a complete operation should one be deemed necessary. He had always believed a great deal in the value of macroscopic appearances, still he would take issue with Dr. Speese, in that he did not think the macroscopic appearance can possibly be of as great value as the frozen section. He would not depend entirely upon a frozen section, but he did think them practically safe and reliable and never operates a suspicious case without the presence of a competent pathologist and his freezing microtome. This plan he had followed for 17 years and had known but two mistakes made in diagnosis by depending upon frozen sections. Very recently some of the most prominent members of the Philadelphia Pathological Society materially differed concerning the nature of a breast he removed at the Presbyterian Hospital. Some thought it sarcoma, others carcinoma, and others still that parts were carcinomatous and parts sarcomatous. These examinations were not made quickly and after frozen sections but weeks and months after the breast was removed. It was referred to a committee for final report. If such differences occur after the better and more accurate way of interpreting the microscope, of course it can, and will occasionally occur when frozen sections are relied upon.

Dr. George G. Ross said that he would not belittle frozen sections, but they are usually made with great haste, the selection of the portion is not always a careful one, and there is great possibility for error. If a portion of the most suspicious part of the tumor were always selected, and if the section were always well stained, these reports would be of much greater value. He believed, however, that the macroscopic appearance, particularly to a man who has had experience, is a better guide in deciding at the operating table. The ideal time for operating on carcinoma is before it really exists.

Dr. George P. Müller said that he did not believe malignancy as a rule occurs in fibroma; in those cases where it does develop he believed it to be accidental or else to be one of the fibrous forms of cystic adenoma, because the tissues are so compressed that the epithelium is practically atrophic and incapable of malignant reversion. With regard to enlargement of breast tumors in pregnancy one should be careful not to attach too much importance to rapid growth during this period. As to the age of the patient, he would take exception to the common statement that

45 is the age at which cancer appears, or that 40 is the age at which the diffused cystic hyperplasia is most apt to be seen. Every one has seen cases of cancer under thirty, and age should have nothing to do with the diagnosis in the individual case. As to the use of the frozen section he agreed with Dr. Speese; he had used it for many years and had come to distrust his own judgment in the matter. He believed with Speese and Bloodgood that the frozen section had not the value that many surgeons attach to it and that more attention should be paid to the naked eye appearance of the growth.

The plastic operation of Warren should be adopted with great caution, and only used in cases of abnormal involution of the cystic type.

LEUKÆMIA RESEMBLING PYONEPHROSIS.

Dr. Francis T. Stewart reported the case of a man aged 47 years, who was admitted to the Jefferson Hospital July 23, 1909, for pyonephrosis which had ruptured into the bowel.

The trouble began 16 years ago after an attack of typhoid fever, when he began to complain of dull pain in the left loin. The pain was associated with a swelling in this region which disappeared with the cessation of the pain. The pain and tumor have come and gone a number of times, sometimes suddenly but more often gradually. They have occurred as often as once a month and have sometimes remained absent for as long as four months. The pain is usually dull and aching in character but occasionally severe and lancinating and sometimes referred to the left testicle. The last severe attack occurred in May, 1909. There was intense and agonizing pain, with fever, sweating, vomiting, and headache. The urinary output was lessened during the attack but towards its end became whitish, profuse, and finally red and fetid. About four days after the onset of this paroxysm he was suddenly relieved of his pain and shortly afterwards passed a large quantity of sanguineous pus by the bowel. Since this time the bowel movements have always contained some pus and blood.

The patient is tall and thin and has lost much weight. The skin is pale and dry and the mucous membrane anæmic. There are many enlarged lymphatic glands in the posterior cervical triangles, both axillæ, and both groins, the largest measuring about 2.5 cm. in diameter. They are painless and freely movable. The thoracic organs are normal.

The abdomen is symmetrical in contour, soft, and not painful. There is an indefinite resistance in the left flank but no rigidity or demonstrable mass. The liver and spleen are apparently normal.

Blood examination: Hæmoglobin 80 per cent., red cells 6,000,000, color index .6, leucocytes 9200. The feces showed blood and pus but no free fat. Rosenberger's test for tubercle bacilli negative. On cystoscopic examination the bladder and ureteral orifices showed no pathological change. A catheter was passed up each ureter to the kidney without meeting with any obstructions. The left kidney secreted 8 c.c. while the right secreted 75 c.c. of urine. The urine from each side was practically identical and showed no abnormality except a few red blood cells; no tubercle bacilli could be found. Methylene blue appeared in the urine from the right kidney in one hour and in the left in one hour and fifteen minutes after being swallowed. No methylene blue appeared in the stools although some of the drug was injected directly into the pelvis of the left kidney. An X-ray examination of both kidneys and ureters showed no stone.

Having improved somewhat while in the hospital the patient decided to leave and to return if the improvement did not continue. In September he was readmitted to the hospital; he had lost more weight and the pain had returned. Upon reinvestigation the spleen could be palpated, and extended from the seventh rib to within two fingerbreadths of the iliac crest. The urine was normal except for a slight trace of albumin. The blood showed: hæmoglobin 65 per cent., red cells 4,300,000, white cells 56,000, color index .7. A differential count of the leucocytes showed polymorphonuclears 6 per cent., lymphocytes 81 per cent., hyaline 7 per cent., degenerated 6 per cent. Later the lymphocytes ascended to 89 per cent. Proctoscopic examination revealed a few small ulcers and numerous polypi, the largest of which was one and a quarter inches in diameter; they were pale, firm and slightly tender. On the 28th of September the temperature rose to 101 and the pain in the loin was severe; during the night the temperature fell to normal, the pain almost wholly subsided, and there was a profuse discharge of pus and blood from the bowel. The following day the spleen could not be palpated.

In this case, in the opinion of Dr. Stewart, the pain and swelling in the left loin are due to engorgement of the spleen, which shrinks as the result of a free hemorrhage into the bowel, a not uncommon complication in leukæmia. The pus in the feces comes from the ulcers and polyps in the rectum and colon; perhaps the latter are leukæmic tumors.

SARCOMA OF THE PSOAS MUSCLE TREATED BY EXCISION, X-RAY AND COLEY'S FLUID.

Dr. Stewart also reported the history of a man, R. G., 27 years of age, who was admitted to the Jefferson Hospital September 12, 1908. In December, 1907, while lifting a heavy stone he felt a sharp pain in the right iliac region, but this subsided after a time and left a dull ache. About four months later he noticed a swelling in the lower right abdomen; this increased in size and finally filled the iliac fossa, almost reaching the median line. It was very firm on palpation but could not be demonstrated with X-ray. It was smooth, and moderately tender, and was intimately attached to the iliac bone. When the thigh was extended there was an audible click in the hip-joint. On September 15, 1908, an incision was made along the iliac crest and Poupart's ligament, severing the muscles of the abdominal wall. The peritoneum was then displaced inwards, the iliac vessels, which skirted the inner side of the growth, retracted towards the median line, and the tumor, together with the iliopsoas muscle, from which it sprang, excised. It was necessary to sever Poupart's ligament in order to cut the muscle close to the femur. The growth had infiltrated the inner table of the ilium over an area about 3 inches in diameter. The bone in this region was removed with a curette and the bleeding checked with Horsley's wax. The wound was sutured except at its upper end, which was left open for the exit of a gauze drain. On microscopic examination the tumor proved to be a round-celled sarcoma. About a month after operation a diffuse swelling could be felt beneath the scar and this was thought to be a recurrence. A sinus still existed at the point where the drain had been placed but there were no evidences of retention of pus or of inflammation. The patient was given X-ray treatment every second day. Two months after operation the skin in the region of the wound became red and tender and the patient was forced to his bed because of fever and weakness. This area of inflammation, probably erysipelas, extended down over the gluteal region and upper third of the thigh. The sinus was still open. The fever lasted about 10 days and disappeared with the subsidence of the inflammation. The swelling in the right abdomen slowly increased in size until the advent of the erysipelatous inflammation, after which it seemed to remain stationary. On February 25, 1909, the subcutaneous administration of Coley's fluid was begun, but no reaction could be obtained, although the dose was run up to 7 drops. On March 3 a new fluid was obtained, 3 drops of which gave a decided reaction. These injections were continued up until March 25, the maximum dose being 8 drops. A second febrile reaction was not obtained. During the administration of Coley's fluid the growth began to shrink, finally disappearing sometime in May, 1909. The X-ray treatment was continued throughout the treatment, and is still given at intervals to guard against recurrence. The patient has gained 40 pounds in weight.

Dr. George P. Müller said with regard to the first case, that he saw one of a similar nature some 8 or 9 years ago when a resident in the German Hospital. A woman of about 35 was admitted to Dr. Deaver's service with a history of having been delivered of a child; six weeks previously she had fever and chills and was thought to have an infected uterus. A blood count made as a matter of routine showed 100,000 leucocytes, and a diagnosis of acute lymphatic leukæmia was easily made.

With regard to Dr. Stewart's second case, he recalled a patient, 28 years old, admitted to Dr. Frazier's wards in the University Hospital, upon whom he operated for a large lymphosarcoma of the neck; this was dissected out and in a month there was a recurrence along the trapezius which was also removed. The patient was then treated with Coley's toxin and is well at the present time and free from recurrence, one year after operation. He had had other cases treated with Coley's toxin with entire failure.

Dr. John H. Gibbon said that he saw both the cases reported by Dr. Stewart. In the first without the blood count one might easily have made the mistake of operating.

The second case reported is the second case he had seen with an apparent cure after the use of Coley's toxin. He had used Coley's toxins religiously in inoperable sarcoma, and even in cases where he thought he had removed the growth. The other case is that of a young girl 16 or 17 years of age upon whom he operated at the Jefferson Hospital in February, 1908, removing an osteosarcoma of the humerus. He wanted to do a shoulder-joint amputation, and explained the situation to the family, but they would not consent, although the girl herself was anxious to have it done. He then started her out on Coley's toxins and also gave her X-ray treatment which Dr. Manges carried out persistently. He did not remember just how long it has been since the operation, but about 18 months, and she is now apparently perfectly well. These are the only two cases in which the combination of the X-rays and Coley's toxins have in his experience worked an apparent cure, although he had combined this treatment in practically all of his cases. This case reported by Dr. Stewart was 27 years of age, Dr. Müller's patient 28, and his own case under twenty, so there are three cases under thirty, and he thought we should therefore continue to use these two remedies in even what appear to be hopeless cases.

Dr. John B. Shober added one case of sarcoma occurring in a young married woman, cured by means of operation and treatment by the X-ray without Coley's toxin. The patient was 27 years of age. Upon operation upon a growth in the forearm he found a cystic spindle-celled sarcoma developing from the interosseous tissue. By an extensive operation he thought he had removed the entire growth, including the cyst wall, but after a few months there was recurrence of the tumor. He then urged operation which she declined. She subsequently fell into the hands of Dr. Pfahler, who treated her with the X-rays and he sent her to see him some years later entirely cured.

His limited experience with Coley's serum in these cases has been disappointing. He would prefer in the future to rely upon first operation and then the use of strong radium bromide, the X-rays, or both.

Dr. William L. Rodman said there is one point in connection with this case, and that is if it does prove to be a radical cure it will be most interesting, insomuch as it was a round-celled sarcoma, which is the least favorable variety for the toxin, as pointed out by Coley himself. Personally he had been using Coley's toxin since 1894 and had seen a decided improvement in many cases but was sorry to say he had not seen a cure in any cases. He had seen several cases cured by the X-rays alone. He had no faith in the treatment of carcinoma by the X-rays as he thought, on the whole, more harm than good had resulted from such treatment. Only superficial epitheliomata are cured by X-ray treatment. It is very different with sarcoma. In all inoperable sarcomata Coley's toxins and the X-rays should be used conjointly as both are often helpful and sometimes curative. He had seen several of Coley's cured cases and a colleague in Louisville, Dr. M. F. Corrum, at his suggestion, used the toxins successfully 13 years ago in a very advanced sarcoma of the throat.

Dr. Francis T. Stewart (in closing) said he had used Coley's toxin in all inoperable cases of sarcoma and in most, if not all, cases of sarcoma after operation, but this was the first time he had had any encouragement. Whether this improvement is due to the Coley's toxin, the X-ray, or the erysipelatous infection, or whether it is due to some other condition of an obscure nature, he did not know.

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ORIGINAL MEMOIRS.

AN X-RAY STUDY OF BONE ATROPHY.*

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By virtue of the earthy matter in bones we get the X-ray shadows. This earthy matter is made up of the three lime salts—the phosphate, the carbonate, and the fluoride of calcium, with a small proportion of the phosphate of magnesia. The X-ray shadow of an element is directly proportional to its atomic weight. The atomic weight of calcium is 40, of magnesium 24. We see then that the calcium salt plays the chief rôle in the density of the shadow. Besides, 64 per cent. of bone is made up of the calcium salts while only 1.16 per cent. is derived from the phosphate of magnesia. Normal bone in the adult holds, therefore, nearly 67 per cent. of the earthy salts, the growing bone something less, the senile bone something more of this proportion.

On account of the solidity of bone we have looked upon it as more inert than the soft tissues. But a moment's thought should dispel this idea, for bone grows and shapes itself under the plastic power of the vital force quite as readily as the soft tissues. And this marvellous plasticity of bone offers to us perhaps the best examples of function determining, of function preceding form. Professor Ernst Müller has beautifully shown this in his paper " Ueber den Bau der Knochen."* We know it clinically, too, in the reparative powers of bone. But the X-ray has shown us in an even more striking way how responsive bone is—how promptly it reacts to all pathological conditions, whether of a purely neurotrophic origin, or of a directly inflammatory cause—and that the proportion of earthy matter in the bone matrix is a sensitive index of the life of the bone. Just so soon as bone becomes diseased just so soon is the proportion of earthy matter disturbed, and a loss of lime salts is one of the first if not the first change to take place. And this change the X-rays promptly record. Thus it is that this new method has proved so valuable in our study of bone pathology, and especially of acute bone atrophy.

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* Paper read before the Georgia Medical Society.

My attention was first directed to the value of the X-ray in the detection of bone atrophy in 1898 when I X-rayed the forearm of an old woman who had broken both the radius and ulna which had failed to unite.

Both proximal and distal fragments had apparently melted away to mere points, which I described in my paper as a " pulled taffy appearance." In this paper, published in the ANNALS OF SURGERY for October, 1898, I wrote:

> " A glance at the radiograph suggests at once the thought that we have to deal here with a neurotrophic change, due to a neurotrosis or nerve injury; that this is an acute process, beginning most probably with an halisteresis or wasting away of the bone salts, followed by a more or less complete absorption of the bone matrix, and leaving only the connective tissue to contract into new fibrous bands or sheaths. The process seems to be for bone what acute muscular atrophy is for muscle, though in all probability a much rarer condition than the latter by virtue of the fact that bone is more stable than muscle. And this case also suggests the thought that non-union after fracture depends directly upon nerve injury or impairment of nerve function."

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* " Ueber den Bau der Knochen," von Professor Dr. Med. Ernst Müller, Stüttgart. Gustav Schloessmann's Verlags Buchhandlung, Hamburg.

X-ray research since then has shown that this atrophy of bone is not a much rarer condition than muscular atrophy, but on the contrary is quite common; that probably pronounced forms of muscular atrophy are always accompanied by some bone atrophy in those bones which are physiologically or anatomically related.

In 1902 another form of bone atrophy was brought to my attention, and the result, too, of a fracture. It was in the form of a bone cyst of the humerus which I operated upon and cured. This case I published in the April number of the Annals of Surgery, in 1902, with a study of bone cysts in general. In my microscopic study of this case I wrote:

> "There is a well-organized lining membrane to the cyst wall resembling somewhat a synovial membrane. There is no evidence of any mucous tissue. The narrow layer of bone, with its thin bony trabeculæ, its numerous cancellous spaces and Howship's lacunæ show in a striking way the advanced atrophy. This atrophy has taken place largely from the cyst side, as shown by a layer of fibrous tissue between the disappearing bone and the lining membrane of the cyst. This fibrous tissue, in places rich in cells undergoing degeneration, represents the ultimate transformation of the bone. In some places the transition from bone to fibrous tissue is beautifully shown. There are no osteoclasts, and the active process of atrophy has probably long ceased. We see but the ruins of the fire. The periosteum has degenerated; it has a granular appearance containing but few cells, and there is no inner osteoplastic layer. . . . There is no sign of any heterologous tissue or any new growth pointing to malignancy. We see simply the result of an old ostitis largely overcome by the vital resistance of the patient, but at the expense of great bone atrophy and impaired function."

These two cases illustrate, I think, the two chief forms of bone atrophy. In the first case we have what we may call the simple or passive form of bone atrophy, where an injury or shock to trophic nerves causes an halisteresis leaving a bone matrix which, if the injury is pronounced and the degenerative process continues, rapidly atrophies to mere fibrous tissue. The highly organized bone has simply reverted to its primitive fibrous tissue. The trophic nerve forces which built this tissue up from its primitive base have lost their grip, so to speak, and the tissue slides back to its original condition.

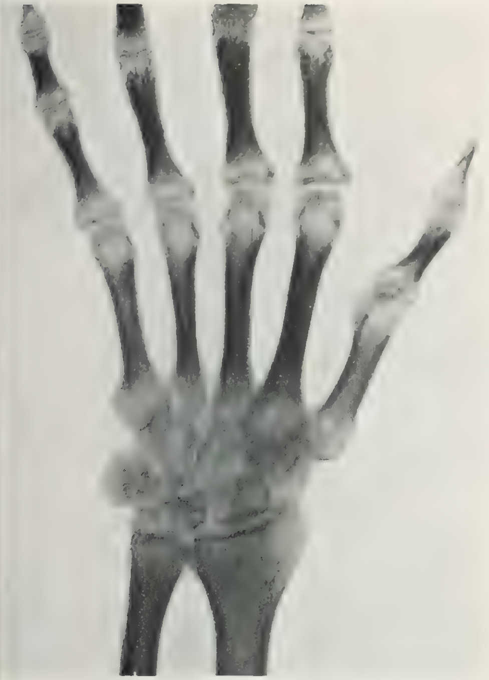
In the second case we have the active inflammatory or pseudo-inflammatory type—what the Germans call the Howship's lacunæ and Volkmann's canals' atrophy—the result of cellular activity, where, instead of osteoblasts which build up we have osteoclasts which break down, each osteoclast digging out its own little hole. This form of atrophy is represented not only by the simple cyst but by cysts of a more active and inflammatory nature, such as pus cysts, abscesses in the bone, and malignant cysts, chiefly sarcomata, also the atrophy of arthritis deformans in its acute and active stage, of tabes, of agromegaly, etc.

The German workers who have studied this subject the most have not indicated any X-ray distinctions in these atrophies, distinctions sufficiently accurate to enable us to diagnose with any certainty the two forms. My own experience leads me to believe that careful X-ray photographs will show certain characteristic features sufficiently to enable us to understand the real pathological conditions present. In my first case the X-ray shows quite clearly, I think, the purely neurotrophic nature of the process, a general halisteresis to start with, followed by a general reversion to simple fibrous tissue. There has been not only a washing out of the bone salts but an absorption of a certain amount of the bone matrix. It is the bone outlines and the trabeculation which are absent. There is an evenness and a smoothness to the shadow. The atrophy is *en masse* and not in spots.

Cases of more pronounced and more extensive atrophy of this type have been reported in the literature. In one case quoted in my paper the entire humerus disappeared and the arm could be twisted around like a rope.

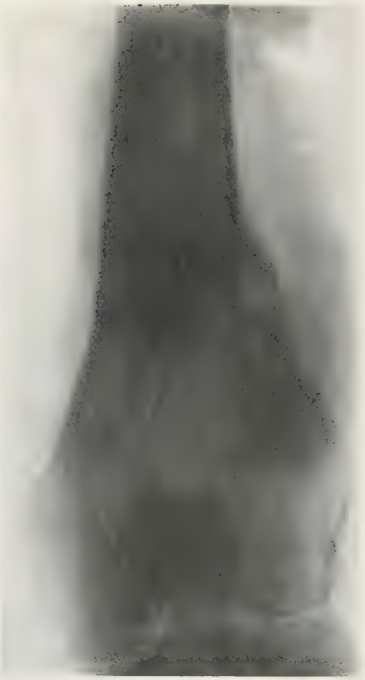
In the osteoporosis of senile bone atrophy we have a form differing entirely from the preceding one. The atrophy occurs in spots and not *en masse*. The epiphyses have become more porous while the shafts of the bones are much less affected. On account of the increased proportion of earthy salts the framework and trabeculæ are sharp and distinct and we have a striking picture of bone detail. In these forms where there is a general dyscrasia or blood condition,

FIG. 1.



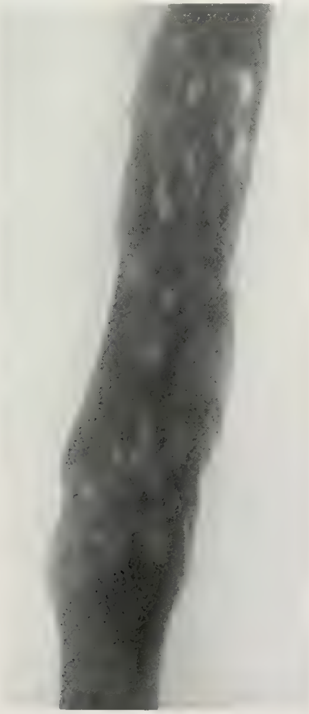
Acute stage of arthritis deformans. Bone salts washed out of the epiphyses and carpal bones. (Reproduced from the *Georgia Practician*, January, 1905.)

FIG. 2.



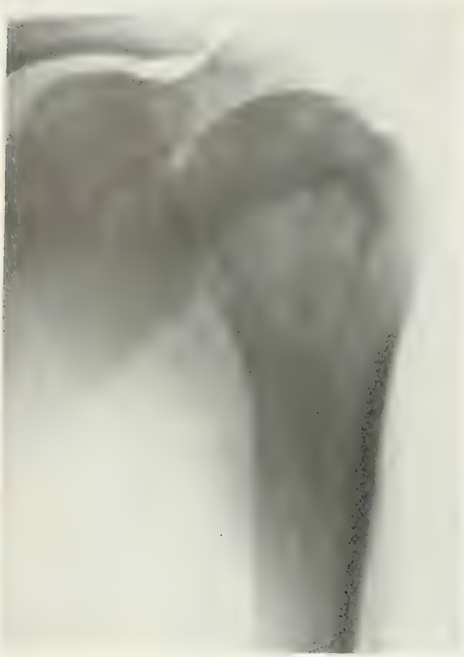
Malignant bone cyst of distal end of femur. Amputation at middle and upper third—no recurrence, showing circumscribed area of diseased bone.

FIG. 3.



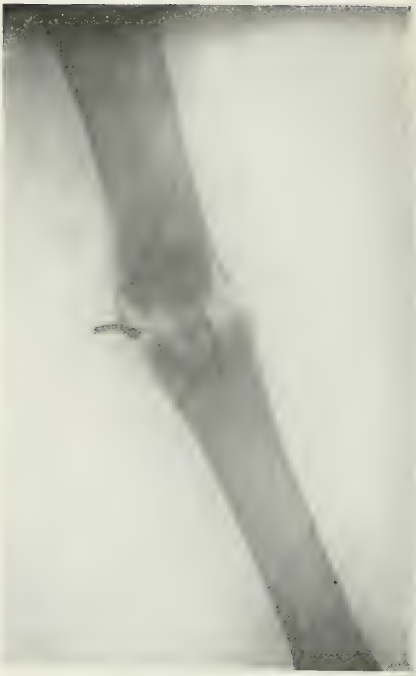
Typical osteitis syphilitica of humerus. (From the *Georgia Practician*, January, 1905.)

Fig. 4



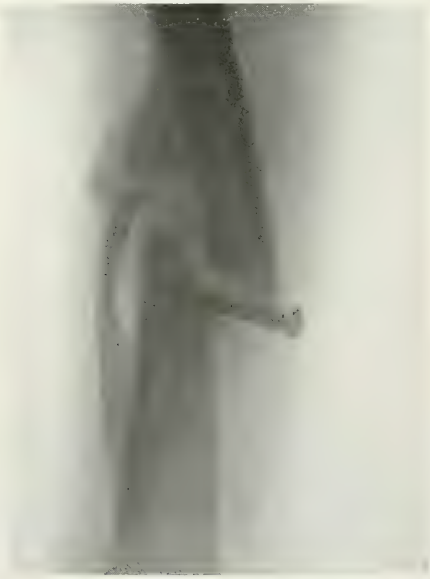
Atrophy in the anatomical neck and tuberosities of the humerus coincident with atrophy of the deltoid following sprain of shoulder joint.

Fig. 5.

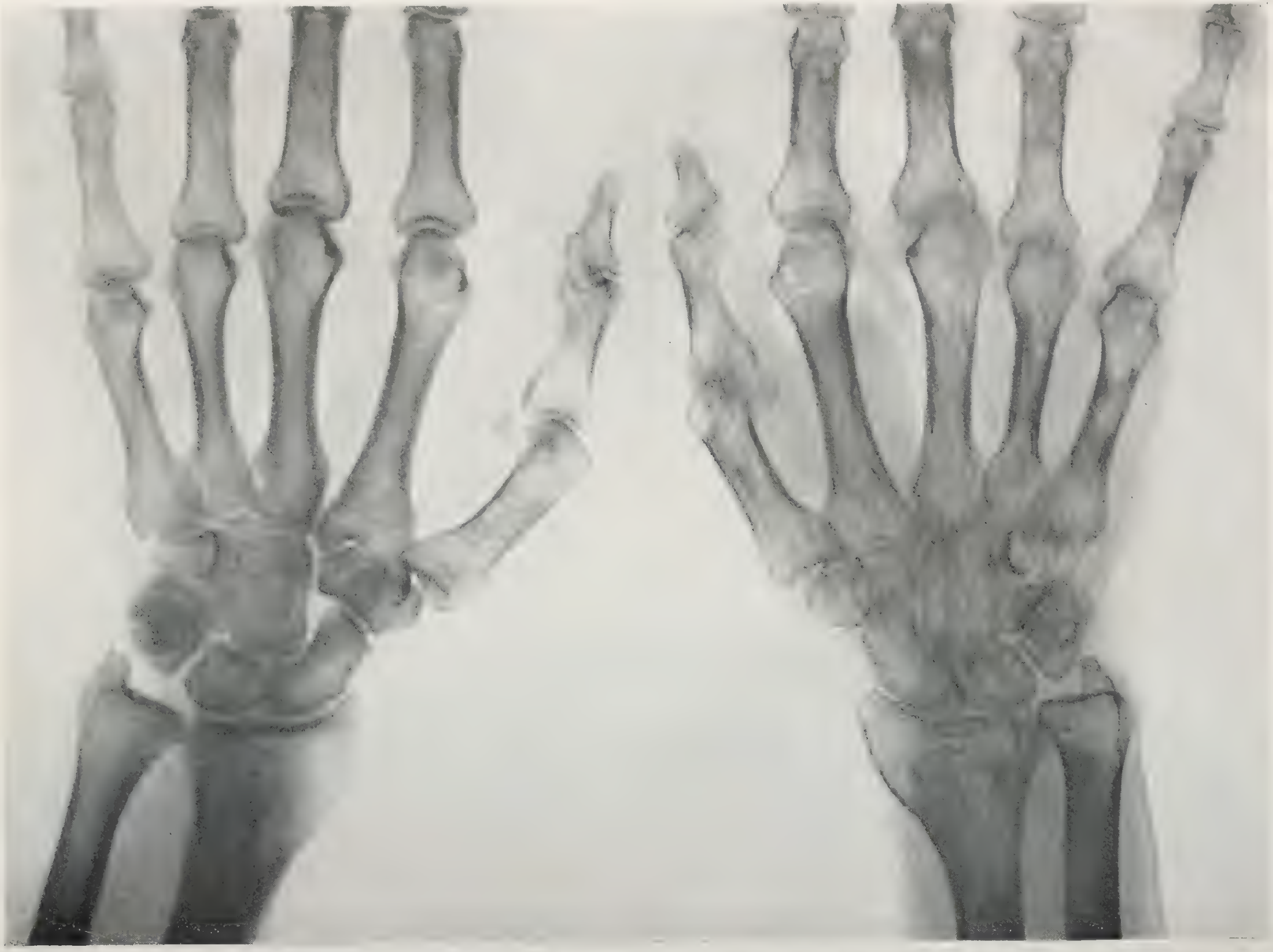


Non-union of fracture of humerus. Humerus of cat used as a pin with wiring of the ends, followed by non-union. Atrophy and softening of the ends of the bone.

Fig. 6.



Fracture of femur at lower and middle third, united by screw bolt, showing the adhesive callus of the ends of the bone, and the fibrous and binding callus of the periosteum. Bolt thrown out by softening of the bone and muscular action.


Right
Left

as seen typically, perhaps, in arthritis deformans in the acute stage, and where there is undoubted inflammation, the X-ray picture is most striking. We find a washing out of bone salts in the epiphyses to be apparently redeposited not far away in the articular cartilages or on the surface of the epiphyses and shafts. It seems to be a case of robbing Peter to pay Paul. See the striking skiagraph of a hand in the acute stage of this disease which I published in the *Georgia Practician* for January, 1905, and which I reproduce here (see Fig. 1). The bony trabeculæ in the washed out epiphyses are drawn as with a sharp-pointed pencil, as a German writer has expressed it.

A pronounced characteristic of the dyscrasic or inflammatory type of atrophy is the circumscribed areas of atrophy with sharp outlines. It may be described as an *atrophia marginata* or *areata,* seen of course typically in the bone cyst, be it simple or malignant. I show a skiagraph of the lower end of the femur containing a sarcomatous cyst (Fig. 2). The X-ray findings are unmistakable. Another form, more inflammatory still, and even breaking down into pus, is the *osteitis syphilitica.* I show an example of this which is very typical and entirely pathognomonic of syphilis (Fig. 3). The skiagraph shows a general periostitis and osteomyelitis of the shaft of the humerus with hyperostosis and characteristic pits or foveæ caused by the breaking down and ulceration of areas of bone infiltrated with a gummatous material. Sections of the bone will show these pits filled with a yellow pulp, the result of fatty degeneration. Most of these pits are shallow, as I found when I cut down on the bone. Note the tooth-like projections of the proliferating periosteum, not unlike shark's teeth, all pointing downwards. Compare this skiagraph with Table XIII in Ziemssen's and Rieder's Atlas of a case of *lues ossium* affecting the radius and ulna, and the same characteristic picture is seen. Late bone atrophy on a syphilitic basis will undoubtedly show much the same picture. And this picture can be easily distinguished from that of necrosis with a sequestrum and cloacæ.

In a general way atrophy of bone occurs first in the epiphyses where the life of the bone is most active. Here it is that halisteresis takes place and gives us such a striking picture on the X-ray plate.

One of the most interesting revelations of the X-ray is the bone atrophy accompanying or following muscular atrophy, whether localized as the result of trauma, or general as the result of spinal troubles as in chronic progressive *poliomyelitis anterior,* or *dystrophia musculorum progressiva.* Of this last disorder Schlippe has reported a most remarkable case in a young man, the first symptoms appearing at the age of five years. The entire skeleton showed atrophy, and especially in the shafts of the lower bones which, although of the natural length, were hardly thicker than an ordinary finger.*

In Fig. 4 I show an interesting skiagraph of the shoulder of a young man who had a pronounced atrophy of the deltoid muscle following a wrench of the joint. There is an evident atrophy in the anatomical neck and in the tuberosities. So far as I know this is the first time this concordant atrophy of bone and muscle has been shown in the proximal end of the humerus, but it is directly in line with many observations made in Germany by Sudeck and others.

The X-ray has taught us a great deal about the atrophy which follows trauma of bone, be it from fractures, gunshot injuries or from surgical interference. Many have been the causes ascribed to the non-union of broken bones, such as poor circulation and blood dyscrasias and many conditions supposed to interfere with nutrition and full development. Outside of great displacement of the broken fragments, leaving a separation too wide for nature to bridge, or from the interposition of muscular tissue between the broken ends, mechanically preventing the formation of a callus, a nerve paralysis must be the real cause of nature's failure to repair the injury. The

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* "Die Röntgenstrahlen im Dienste der Neurologie," von Dr. Wilhelm Fürnrohr. Berlin, 1906, p. 143.

X-ray shows us that nature has either failed to throw out a callus, or we see an atrophy of the broken ends of the bones. As a general rule we find the character of the callus dependent upon the extent of the initial injury. Where this is severe the callus is slow to form and slow to ossify, and where nerve injury is slight there is a quick reparative response in the bone.

Figure 5 is a skiagraph of an ununited fracture of the humerus where I made two unsuccessful attempts to unite the broken ends. At the first attempt I simply wired the bones and put up the limb in plaster. At the second attempt I transplanted the fresh humerus of a cat killed in the operating room at the time of the operation, and the bone removed under as careful aseptic precautions as possible. The bone was driven into the medullary canal and the ends wired in addition. The cat bone acted as a pin to help hold the bones together in alignment. There was no union and the X-ray helps us to understand the failure. Not only did the silver wire break, but in the skiagraph can be seen the atrophy of the ends of the bone and an area of atrophy around the cat bone. To the original trauma I but added more trauma. The experiment was ill advised. Were I to further experiment in this direction I should be inclined to transplant periosteum rather than bone, covering the gap between the broken ends with a cuff of periosteum, trusting that there might be sufficient life left in the periosteal graft to encourage bone growth. I have carpeted the scraped floor of the frontal sinus with skin grafts from the thigh and seen them grow, and why not periosteal grafts?

This sensitive response of bone to injury and its delicate dependence upon nerve integrity shows us the great importance of the elimination of trauma in all operative work. And this is especially so in all secondary operations with the idea of correcting a poor alignment or an excessive callus, interfering with motion or pressing upon neighboring parts. Much force is necessary to cut away such callus and nature moreover seems loath to repeat her reparative process.

Figure 6 is from another skiagraph of great interest bearing on this point.

A boy of 14 years broke his femur which I put up in plaster but which failed to unite properly on account of a poor alignment and the probable interposition of muscular tissue. At any rate the flimsy callus broke down on his first attempt to walk. I decided then to bolt the broken ends. I made a scarf joint, bored the ends with a gimlet, and with a screw-driver screwed the bones firmly together with a screwbolt of nickeled iron. The bones were so firmly united that I and my assistant thought it unnecessary to hold the screw with a nut, which we were prepared to do. The boy got firm union but with some displacement of the fragments and some shortening, of course. The skiograph taken at the end of two months shows the following conditions: The bone around the bolt softened and absorbed, destroying thus the original firm hold of the bolt, and the muscular pull simply threw it out. You can see the atrophied bone in the track of the bolt. The arrangements and structure of the callus thrown out is very interesting. The X-ray shows two kinds of callus, an apparently amorphous callus thrown out from the ends of the bone to glue them together, and a fibrous periosteal callus acting like a splint. This bony callus starts at least 3 cm. from the proximal end and 5 cm. from the distal end of the break, and extends still further back 4 cm. This shows the paralyzing effects of the operation on the periosteum at the freshened ends of the bone and that this influence was felt as far back as 3 or 4 centimetres.

Sensitive bone reacts not only directly to injury of its own nerves but indirectly to nerve injuries of adjoining soft parts. It is a reflected atrophy. We know how often an original synovitis in a joint secondarily causes atrophy of the muscles inserted into that point which are in physiological as well as anatomical relationship with it. On the other hand the X-ray shows a reversal of this sequence where a primarily affected muscle is followed by an atrophic process in the adjoining bone. Sudeck has noted this bone atrophy as soon as four and a half weeks after the initial injury and that this bone atrophy is much slower in disappearing than the atrophy of the soft parts.

Figure 7 exhibits bone atrophy following a case of Colles' fracture. Bad cases of this fracture in elderly people are often followed by a long persistent swelling of the soft parts, with trophic changes in the skin. The skin is red and shiny and sensitive on pressure; the nails are ridged and brittle, the hairs have dropped out, and the wrist and other joints of the fingers are stiff and painful on motion. An X-ray of such a hand will invariably show accompanying atrophic changes in the bones. The fracture was in the left wrist while the right wrist was simply sprained and did not suffer much reaction. The atrophy is very apparent in the carpal bones and in the metacarpal and phalangeals, the shafts participating with the epiphyses. The entire hand becomes aged, and the bone atrophy closely corresponds with the osteoporosis of senility. This condition bears a direct relationship with the extent of the initial injury, and points I think very strongly to the necessity of reducing promptly the initial swelling and inflammation. Treat the case as a sprain rather than as a fracture and use hot fomentations and massage rather than an immovable splint. While these atrophic changes are more common in the old hand I have also seen them in the young.

No one can do X-ray work without meeting with these various forms of atrophy, some acute and evanescent, some chronic and permanent. An interesting research in this direction is an X-ray study of old injuries, and the condition of bone long after operative work. We find hypertrophic changes as well as atrophic, though the latter condition is far more common.

As I have stated, it is the German workers who have done the most for us in this research. In a work by Dr. Wilhelm Fürnrohr entitled "Die Röntgenstrahlen im Dienste der Neurologie," the X-ray in the service of neurology, there is an exhaustive treatment of this whole subject of bone atrophy, acute and chronic, and its frequency and extent in the various diseases of the nervous system, central and peripheral.

While it was long known that bone atrophy formed an important part of tabes, arthritis deformans, agromegaly, certain tertiary and inherited forms of syphilis, rachitis, and certain traumatic lesions of bone, our knowledge of the subject was limited, based as it was on post-mortem findings only and on the slow and laborious method of microscopic section. With the X-ray we had at once a widening of the horizon. We not only got a detailed view, but a bird's-eye view of the entire field. But the greater part of this increased knowledge was in an unsuspected direction, for pronounced bone atrophy was found in certain diseases supposed to be limited to the soft tissues only. Bone atrophy has been found with the muscular atrophy following cerebral hemiplegia, in polienceph-alitis infantiles acuta, and in dementia paralytica associated with a fragilitas ossium. In that strange disease *dysostose cleidocranienne,* first described by Marie and Sainton in 1897, characterized by an exaggerated development of the transverse diameter of the cranium, with delayed ossification of the fontanelles, and marked atrophy of the clavicles, the X-ray has given us most valuable information of the extent of the atrophic changes.

In certain forms of psoriasis associated with pronounced nerve disorder, the X-ray has shown certain joint conditions not unlike those of tabes and syringomyelia, both of an hypertrophic and atrophic nature. In the acute and chronic forms of anterior poliomyelitis, in the muscular atrophies, in the dystrophia musculorum progressiva, in myelitis, and in spinal meningitis, atrophic bone changes have been found by the X-ray.

In the many forms of peripheral nerve troubles, the acute *neuritides* and neuralgias, and paralyses, such as ulnar paralysis, intercostal neuralgia, coxalgia, metatarsalgia, achillodynia, and even herpes zoster, trophic bone changes have been found. In some obscure cases of paralysis of uncertain origin, or of doubtful hysterical origin, the X-ray may help in the diagnosis, for the evidence of bone atrophy in pure hysteria is so uncertain as to be quite negligible. In some hysterical conditions, however, associated with organic nerve troubles, the separation by X-ray may be very difficult or impossible.

In those interesting vasomotortrophic neuroses, such as erythromelalgia, Raynaud's disease, schleroderma, and schlerodactylitis, pronounced bone atrophy has been found. In certain diseases dependent upon disturbed or absent internal secretions, such as agromegaly, gigantism, adipositas universalis, myxœdema, micromelia, achrondroplasia, chondrodystrophia hyperplastica, where we find forms of hypertrophy and of dystrophy, we are sure to find in addition forms of atrophy, affecting equally soft tissues and bone.

This ever-widening horizon in our knowledge of pathology, as well as that of the normal life, but brings out more clearly the marvellous sympathy and interaction of all the tissues of the body. Bone is quite as alive as muscle, responds quite as readily to vasomotor impulses, and feels even more keenly the cut of the knife or the blow of the bullet. In perverted growth and congenital deformities bone seems even more liable than the soft tissues to go astray. It will be well for us to remember this in our bone surgery; it will make us more mindful of the greater power of the gentler force, and even give us more faith in the recuperative power of bone. Bier must have had this in mind when he made his discovery; and to see tubercular bone recover itself through the blocked or retarded circulation of the elastic bandage, is the best evidence of the responsive vitality of bone. I hope shortly to show by skiagraphs this recuperative power of tubercular bone.

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THE RADICAL EXTIRPATION OF PHARYNGO-ŒSOPHAGEAL PRESSURE DIVERTICULA.

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The publication of the very excellent monographs of Starck and Rosenthal in 1900 and 1902 respectively on the diverticula of the œsophagus has left little to be added to the etiology, mechanism, pathology, symptomatology or diagnosis of this interesting condition. As is well known, it was Zenker who in 1877 first divided these œsophageal pouches into two main types—the pulsion or pressure diverticulum, produced by force exerted from the inside of the tube, and the traction diverticulum, due to a pull from the outside (usually inflammatory adhesions from carious vertebræ, tuberculous bronchial lymph-nodes, etc.). Occasionally the latter become converted into the former type. I shall speak, however, of only the pure pressure sac, and incidentally wish to call attention to a peculiar error of translation, that has crept into the English literature and that is apt to be misleading. The German term " Pulsion " has been more or less universally translated into the English word "pulsation." Of course these diverticula do not pulsate, and the word " Pulsion " was merely used to designate their mode of production. The mistake is obvious.

While the pressure diverticulum may occur in the pharynx itself and also in various parts of the intrathoracic œsophagus, the most frequent and characteristic location is at the junction of the pharynx and œsophagus, posteriorly. For this reason it has also been called pharyngo-œsophageal diverticulum, boundary diverticulum and pharyngocele. These pouches usually lie a little to the left, vary greatly in size, have a distinct neck and are most commonly found in males over forty years of age. The facts that they have never been found in early life, that symptoms rarely develop before more advanced age and that they invariably lack a complete muscular coat speak against their being a congenital anomaly, either in the form of an arrested development or an atavistic variation. The evidence is in favor of their being an acquired condition, the predisposing factors of which are:

First, the normal anatomical deficiency of the longitudinal muscular fibres of the upper end of the œsophagus, the so-called Laimer's triangle.

Secondly, the normal physiological stenosis and rigidity with the sphincter-like action of the entrance of the œsophagus, the so-called "Œsophagusmund" of Killian.

Thirdly, pathological narrowing of the lumen of the upper part of the gullet, such as that produced by a struma, stricture, etc.

The exciting causes are:

First, injury from sharp or hard swallowed particles.

Second, and most important, the constant pressure of the food in the normal act of swallowing.

The main disturbance is a dysphagia, the bolus entering the sac which distends and compresses the gullet. Occasionally a tumor, varying in size according to the distention of the pouch, is present in the neck, and not infrequently a *fetor ex ore* from decomposition of the retained food in the sac is a very annoying symptom. The course of the disease is a chronic one and if untreated the condition leads to starvation, or aspiration pneumonia or pulmonary gangrene may develop. The sac may perforate and this perforation may induce a mediastinitis. Carcinoma has been known to develop in the pouch.

Particularly do I wish to emphasize from the diagnostic stand-point the characteristic variability in the results of the sounding, the instrument sometimes passing and sometimes either entering the opening of the pouch or simply being caught at that point. A so-called diverticulum bougie, recommended by Berkhan and others and constructed on the principle of the coudé catheter, may pass the orifice when the straight sound does not. The most important aid to diagnosis, however, is the X-ray, which shows the bismuth distended sac with remarkable distinctness. The œsophagoscope has been used to a great extent for diagnosing this affection, but I believe that it can tell us little that has not been elicited by the bougie and radiograph and that its introduction is scarcely warranted.

The treatment may be symptomatic or curative. The latter may be conservative (sounding, faradization, cauterization, etc.) or radical and whenever the patient's condition justifies it, the radical, first, according to König, suggested by Kluge, is to be preferred. It is only within the past two decades, however, and especially since the Röntgen era has rendered early diagnosis possible, that this disease, which is not such a rarity as is ordinarily supposed and of which the number of reported cases has reached into the several hundreds, has really been brought within the domain of operative surgery and removal of the sac has been followed by sufficient success to warrant its universal adoption. The cases operated upon and reported are not so very numerous, however, and certain details of technic are still so much under discussion that I feel justified in recording the following successful case, which is not only interesting from the technical aspect but also because it illustrates two very important clinical points:

First, that not every spontaneous organic œsophageal stenosis developing after middle life is due to a carcinoma.

Secondly, that proper radiographic studies are positively indispensible in the diagnosis of diseases of the œsophagus.

M. L. E.,* male, age 65 years. The patient's mother died of a cancer of the breast. He was born with an extreme right talipes equinovarus. He had the ordinary diseases of childhood, passed through an attack of typhoid at the age of 21 and has had a reducible left inguinal hernia for seven years. On June 26, 1907, he sustained an intracapsular fracture of the right femoral neck, which healed by fibrous union and fairly good function.

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* Patient presented at the Surgical Section of the New York Academy of Medicine, November 5, 1909.

His present illness began in August, 1907, over two years ago. Without any history or indication of tuberculosis or lues, of swallowing caustics or of traumatism of any sort, he noted a gradually increasing difficulty in deglutition, particularly with larger pieces of food. There was no pain, but occasional regurgitation. I had no opportunity of making an œsophageal examination until some months later, when his symptoms became more marked, even the swallowing of liquids being difficult and a violent attack of coughing and choking calling my attention to the seriousness of the malady. My bougie was obstructed at about 16 to 19 centimetres from the teeth, that is, at a point slightly below the level of the cricoid cartilage. By repeated manipulation, however, I was finally able to enter the stomach with a No. 24 French and later with a No. 32. The bougieing dislodged a piece of meat, which had apparently been caught at the stricture. The examination of the chest and larynx revealed nothing of significance and the general nutrition of the patient was very fair though he had lost some weight. At the second examination, a week later, it appeared that the stenosis was tighter, as only a No. 28 French could be passed and that with difficulty. The diagnosis of carcinoma of the œsophagus, at a not infrequent site, was almost obvious. I attempted to confirm this impression by a hypopharyngoscopic examination after v. Eicken and Gerber, but without success. I decided to dispense with the œsophagoscope, as I deemed it unnecessary and did not wish to subject the patient to the risk and great annoyance. Two other New York surgeons saw the patient with me at that time and both agreed with my diagnosis and the indications for treatment, namely, that a gastrostomy should be done while his condition was still favorable. I did a Witzel operation on January 9, 1908, from which he made an uneventful recovery.

During the following sixteen months the course of the disease was most gratifying and surprising. Instead of the patient going rapidly down hill, he not only held his own very nicely but he actually gained eight pounds in weight. His dysphagia was variable. Except for a period of forty-eight hours, about two months after his gastrostomy, when he had an attack of acute laryngitis and was unable to swallow even water, he has always been able to take his regular meals. During this attack of total dysphagia with hoarseness it was first assumed that a perforation of the larynx from the cancer was imminent, but when both symptoms subsided under inhalations and an adrenalin spray, it was thought that a collateral œdema from an acute laryngitis had converted the carcinomatous stricture into a complete atresia. There has perhaps been an improvement in his ability to swallow solids, while liquids have gradually been causing him more difficulty. When he drinks there is a distinct " Durchpressgeräusch." Particularly annoying have been a cough after eating and on lying down at night, which has been somewhat less distressing in the past few months. The result of the bougieing is very significant. At times I was able with the greatest ease to pass the sound into the stomach, while at others repeated attempts were absolutely unsuccessful, the bougie being always arrested at about the same level. I thought this variability was due to a tortuous stricture. I never succeeded in passing a larger number than 23 French after the operation. A slight fulness is present in the neck but there is no distinct, palpable tumor.

It now became evident that our original diagnosis was incorrect and I appealed to the X-ray for assistance. This was forthcoming in most definite fashion. The radiographs here reproduced illustrate the following points *:

Figure 1 is a lateral view showing an accumulation of bismuth paste in a dilated hypopharynx above a stricture located at the level of the seventh cervical vertebra.

Figure 2 is an anteroposterior view showing a perfectly circular accumulation of bismuth paste just above the suprasternal notch, slightly to the left of the median line. In the original negative it is about 3.5 centimetres in diameter and is undoubtedly a typical pharyngo-œsophageal pressure diverticulum, which by compression and deviation of the gullet has produced the stenosis noted in the first plate. The arch of the aorta is somewhat dilated.

Figure 3 is an oblique view showing the same sac filled with bismuth lying on the second dorsal vertebra and behind the œsophagus, which is seen partly outlined by a bismuth streak.

The relations of the sac to the larynx, hypopharynx, œsopha-

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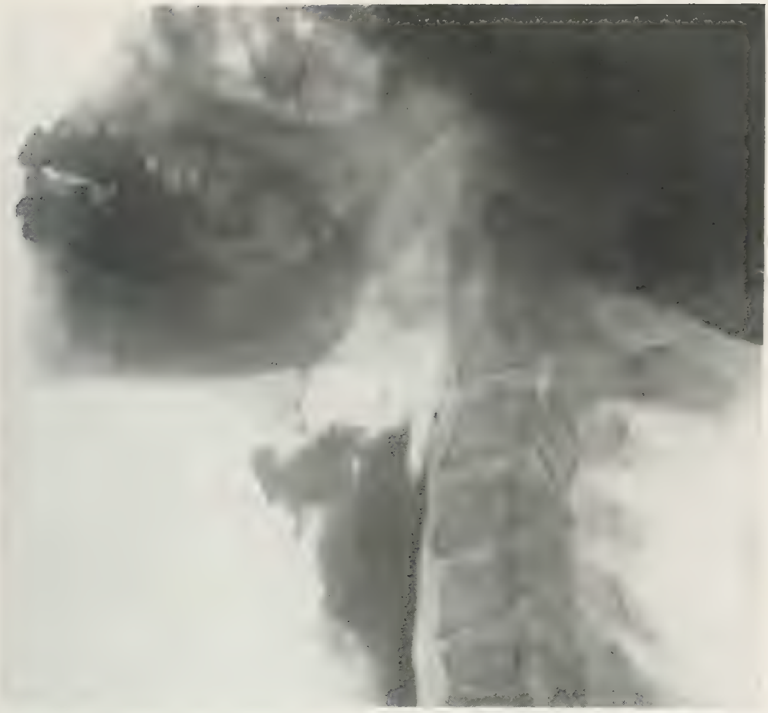
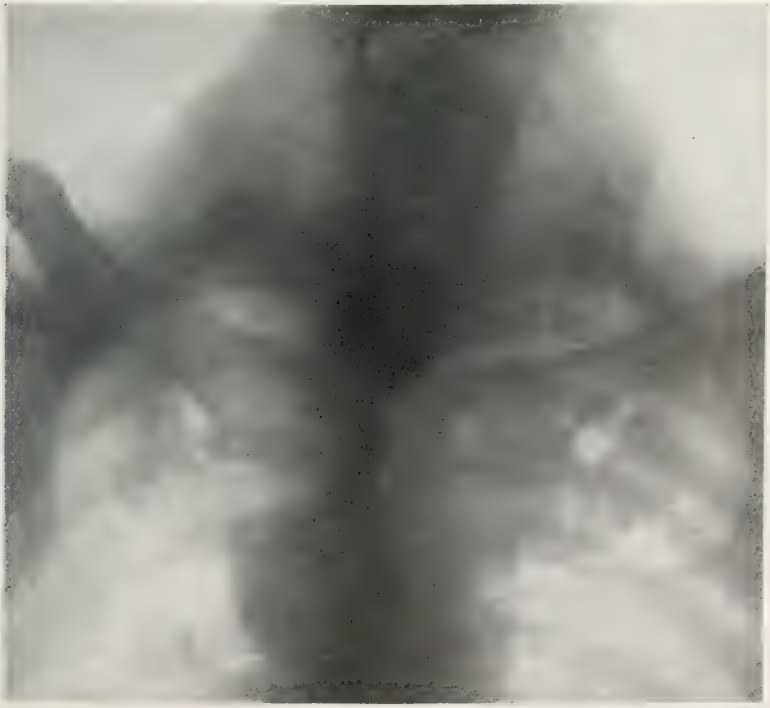
* The author desires to acknowledge his indebtedness to Dr. L. G. Cole for the excellent radiographs.

Fig. 1.



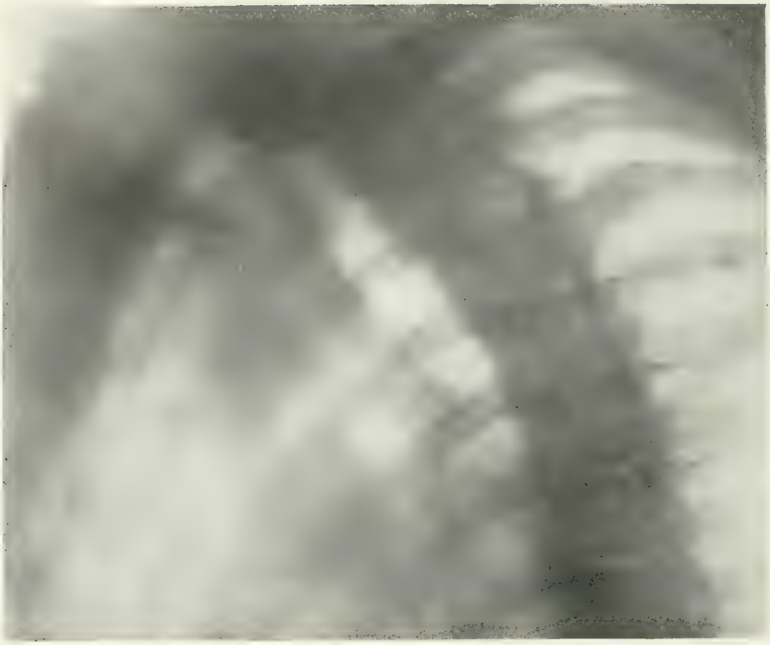
Radiograph, lateral view, showing accumulation of bismuth paste in dilated hypopharynx above stricture located at level of seventh cervical vertebra.

Fig. 2.



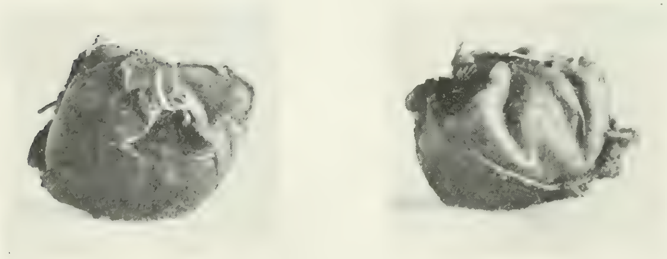
Radiograph, anteroposterior view, showing circular accumulation of bismuth paste (diverticulum) just above suprasternal notch and slightly to left of median line and somewhat dilated arch of aorta.

FIG. 3.



Radiograph, oblique view, showing sac filled with bismuth lying on second dorsal vertebra and behind œsophagus, which is partly outlined by bismuth streak.

FIG. 5.



Two photographic views of diverticulum (three-quarters size).

gus, sternum and spinal column appeared to be as indicated in the diagram, Figure 4.

As the patient's general condition, except for a slight arteriosclerosis, was excellent and as he wished to be freed from his symptoms and gastric fistula, operation was decided upon after the risk of operative interference had been carefully explained to him.

FIG. 4.

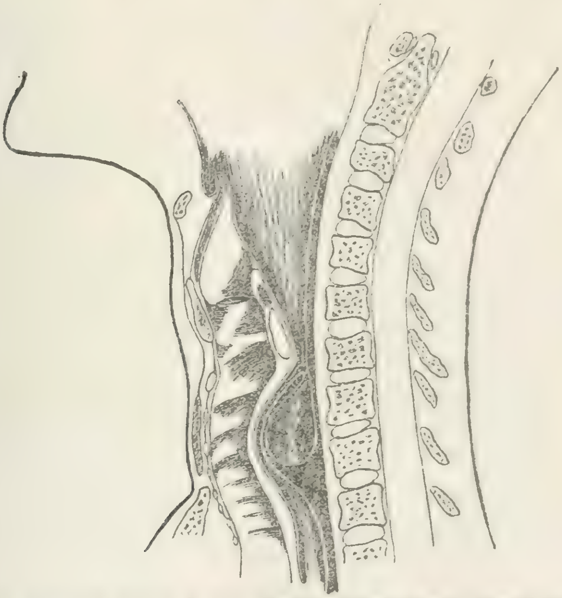


Diagram of sagittal section of neck showing relations of sac to larynx, hypopharynx, œsophagus, vertebral column and sternum, as anticipated from radiographs and found at operation. Note deviation and compression-stricture of œsophagus.

His teeth were first put in perfect order and thoroughly cleaned by his dentist and he was admitted to the German Hospital on May 12, 1909. All feeding *per os* was at once discontinued and he was nourished exclusively through his gastrostomy. He was urged, however, to drink large quantities of sterile water through the natural passages in order to wash out any remnants of food in the sac. The teeth and tongue were frequently cleansed and an antiseptic mouth-wash ordered.

On May 15, 1909, after it was felt that the upper portion of the alimentary canal was in as aseptic state as it was possible to procure, the radical extirpation of the diverticulum was performed.

One-half hour before operation the patient was given hyperdermatically morphin sulphate gr. ¼ and atropin sulphate gr. $^1/_{100}$. Under anæsthol anæsthesia a 10-centimetre incision was made along the anterior border of the left sternocleidomastoid muscle, from about the level of the greater cornu of the hyoid bone to the suprasternal notch. After cutting through the platysma, the incision was deepened in the line of cleavage between the sternohyoid and omohyoid muscles, the middle layer of the deep cervical fascia was divided and the vessels and vagus in their sheath were retracted with the sternocleidomastoid and omohyoid outward, while the larynx, thyroid gland, and sternothyroid and sternohyoid muscles were retracted inward. The recurrent laryngeal nerve was not seen but was evidently pulled medially by this latter retraction. A small bougie was passed into the œsophagus from the mouth, and then at about the level of the cricoid cartilage was seen a small sac, apparently the size of a small walnut, smaller than the X-ray had led one to suppose. It was situated behind and to the left of the œsophagus, just as I had assumed from the radiograph (Figure 4), and its base lay towards the posterior mediastinum. The sac was grasped with a blunt forceps and easily freed by blunt dissection from the surrounding tissues till its neck was exposed. It was then seen to emerge through an opening just below the inferior constrictor, some fibres of which apparently spread themselves over the sac. The sac gave the impression of being simply a hernia of the œsophageal mucosa.

The neck of the diverticulum was ligated close to the œsophagus with a stout catgut ligature, a clamp was applied distally and the sac was divided between these with the Paquelin. The muscular coat was then sutured longitudinally by interrupted catgut sutures in two layers, the cauterized stump being buried.

Free drainage was provided by means of gauze tampons to the bed of the sac in the posterior mediastinum and a cigarette drain to the stump. The drains were led through the lower angle of the wound, the upper portion being sutured with silk.

Aside from a slightly accelerated respiration and a pharyngeal cough which subsided after a few days, the patient's recovery was uneventful. His temperature never exceeded 100.8 degrees. He was at once given a peroxide mouth-wash, urged to breathe deeply, expectorate and not to swallow saliva. He was allowed out of bed forty-eight hours after the operation. He was given nothing *per os* and fed exclusively through his gastrostomy for five days, after which he was permitted to take sterile water in small doses. After a week he was taking all fluid nourishment by mouth and in ten days he was on a regular, full diet. He swallowed without difficulty.

The sutured portion of the wound healed primarily. The drains were changed on the sixth day. There was no leakage from the œsophagus and the drainage wound began to close promptly.

On the tenth day after operation a No. 34 French bougie was easily passed, though one could detect a slight catch at the point where the diverticulum had been. The following day a No. 36 was introduced without difficulty and the gastrostomy tube removed. He left the hospital June 1, 1909.

The drainage wound was entirely closed within three weeks from the date of operation. The patient has been completely freed of his symptoms, he eats his meals with relish, his swallowing is perfectly normal, he has no cough and he has gained about ten pounds in weight. His gastric fistula, except for an occasional cauterization, closed spontaneously in about four months. I bougie him with a No. 36 French every three weeks. There is still a catch at the old site, probably due to a deviation of the gullet, but I find that by inserting the bougie obliquely from right to left it enters easily.

The specimen is a small rounded sac (Figure 5), which can be stretched to the size of a walnut, and which has a circular opening at the point corresponding to the neck about 0.5 centimetres in diameter. It is lined with mucous membrane and the walls seem to consist mainly of somewhat thickened, fibrous submucosa covered in parts, particularly at the neck, with strands of muscular tissue.

The microscopical examination confirms the above impression. It shows the lining of comparatively normal, œsophageal, stratified epithelium. The wall consists mainly of a somewhat hypertrophic submucous connective tissue with an indication of a muscularis mucosæ and externally scattered, striped muscular fibres. This outer muscular coat is very incomplete, especially at the fundus of the sac.

I was stimulated by interest in the above case to make a thorough search of the literature of the radical operative extirpation of œsophageal diverticula. The tables on pages 309 to 311 represent the cases I have succeeded in collecting, arranged chronologically according to the date of publication and grouped as per operative method used. I have not included those cases where such conservative surgical measures were used as mere œsophagostomy with only opening of the sac (Nicoladoni) or simple gastrostomy (Whitehead, Chavasse and others). These procedures are only indicated where the condition of the patient does not warrant more radical interference.

Of the total of 60 radically operated cases by the various methods, 50 were cured and 10 died, a mortality of only 16.6 per cent. Among the 48 cases of direct excision there were 9 deaths, a mortality of 18.7 per cent. Of the 5 patients on whom a preliminary gastrostomy had been performed before the sac was excised 1 died, a mortality of 20 per cent. All the cases operated by the other methods recovered. The causes of death were inanition, infection and sepsis, pneumonia or pulmonary gangrene, hemorrhage, colitis, and suppression of urine.

In 21 of the 50 cases which recovered it is definitely stated or to be inferred that primary union of the œsophageal wound was obtained. In all of the others there was either primary or secondary leakage, or both. There have been no recurrences.

These results, considering the gravity of the disease and the usual advanced age and poor nutrition of the patients are certainly gratifying and warrant the advocacy of radical treatment in all cases where the condition of the patient is at all fair. There merely remains to be decided which is the best method of radical operation to be pursued. To help solve this question I take the liberty of submitting the following conclusions, based upon my personal experience and my analysis of the previously operated cases (see page 311):

TABLE I.—DIRECT EXCISION OF SAC WITHOUT PRELIMINARY GASTROSTOMY.

No.	Author	Operator	Date of Publ.	Date of Oper.	Leakage	Result	Remarks.
1	Wheeler	Wheeler	1886	1885	App. no	Cured	Also pharyngeal pouch cured.
2	Zesas	Niehans	1889	1888	Yes	Death in 14 days from inanition	Secondary gastrostomy, 1st stage.
3	v. Bergmann.	v. Bergmann	1892	1890	Yes, prim. and second.	Cured	
4	Kocher	Kocher	1892	1891	Yes	Cured	
5	Kocher	Kocher	1892	1892	No	Cured	
6	Kocher	?	1892	?	?	Death from phlegmon	
7	Kocher	?	1892	?	?	Death from phlegmon	
8	Butlin	Butlin	1893	1892	Yes	Cured	
9	Schwarzenbach	Billroth	1893	1892	Yes	Cured	
10	Bayer	Bayer	1894	1893	Yes	Cured	Stomach tube into œsophagus wound.
11	v. Mandach	v. Mandach	1894	1893	Yes	Cured	
12	König	König	1894	1894	No	Cured	
13	König	König	1894	1894	Yes	Cured	
14	Mixter	Mixter	1895	1894	Yes	Cured	
15	Girard	Niehans	1896	1884	Yes	Death in 24 days from hemorrhage from superior thyroid	Also strumectomy.
16	Butlin	Butlin	1898	1895	Yes	Cured	
17	Butlin	?	1898	1897	?	Death in 2 days from urinary suppression	
18	Bartelt	Kraske	1898	1896	No	Death in 4 days from bronchopneumonia and pulmonary gangrene	
19	Hearn	Hearn	1899	1896	App. no	Cured	
20	Richardson	Richardson	1900	1898	No	Cured	
21	Richardson	Richardson	1900	1899	Yes	Cured	Also plastic.
22	Depage	Depage	1900	1899	App. yes	Cured	
23	Goris	Goris	1900		Yes	Cured	
24	Veiel	v. Bruns	1900	1899	No	Cured	Also strumectomy.
25	Veiel	Poelchen	1900	1900	Yes	Cured	Stomach tube into œsophagus wound.
26	Mayr and Dehler	Schönborn	1901	1900	No	Cured	
27	v. Mikulicz	v. Mikulicz	1902	?	?	Cured	
28	Butlin	Butlin	1903	1898	Yes	Death in 7 days from sepsis	Stomach tube into œsophagus wound.
29	Butlin	Butlin	1903	1899	Yes	Cured	
30	Butlin	Butlin	1903	1899	App. no	Cured	

TABLE I. (*Continued.*)—DIRECT EXCISION OF SAC WITHOUT PRELIMINARY GASTROSTOMY.

No.	Author	Operator	Date of Publ.	Date of Oper.	Leakage	Result	Remarks.
31	Butlin.......	Butlin.......	1903	1900	Yes	Cured	
32	Butlin.......	Butlin.......	1903	1900	App. no	Cured	
33	Butlin.......	Butlin.......	1903	1902	Yes	Cured	Stomach tube into œsophagus wound.
34	Brun.........	Krönlein.....	1903	1902	No	Cured	
35	Fischer.......	?	1903	?	?	App. cured	
36	Phocas.......	Phocas.......	1903	1903	Yes	Cured	Catheter into œsophagus wound.
37	Bickel........	Kümmel.....	1904	1904	Yes	Cured	
38	Schlie.........	Müller........	1905	1903	No	Cured	
39	Capart.......	Capart.......	1905	1903	Yes, second.	Cured Cured	
40	Harmer......	?	1905	1904	Yes	Death in 20 days from bronchopneumonia	
41	Grant........	Grant........	1905	1905	App. no	Cured	
42	Barrow and Cunning	Barrow.......	1905	1904	No	Cured	
43	Zesas........	Rotter.......	1906	1903	?	Death from aspiration	
44	v. Bergmann.	v. Bergmann .	1906	1906	?	App. cured	Report 4 days after operation.
45	Pollard.......	Pollard.......	1907	1904	No	Cured	Complicating pneumonia.
46	Tillmann.....	Tillmann.....	1908	1908	No	Cured	
47	Brewer.......	Brewer.......	1908	1908	No	Cured	Also division of stricture.
48	Taylor........	Taylor.......	1909	1908	No	Cured	

* Although I have been unable to find the original reference I have included Rotter's case, quoted by Zesas and supposedly described at the Thirty-second German Surgical Congress (1903) in the above table. The case of Godlee and Bucknall, also quoted by Zesas, has been omitted as it was a pharyngeal pouch and does not belong to our group.

TABLE II.—DIRECT EXCISION OF SAC WITH PRELIMINARY GASTROSTOMY.

No.	Author	Operator	Date of Publ.	Date of Oper.	Leakage	Result	Remarks.
1	Hoffmann....	Witzel........	1899	1897	Yes	Cured	
2	Hoffmann....	Witzel........	1899	1899	No	Cured	
3	Veiel.........	v. Burckhardt	1900	1884	No	Death from pneumonia and colitis	Death due to 1 % sublimate irrigation of wound.
4	Klotzsch.....	Helferich.....	1902	1901	?	Cured	
5	Stetten.......	Stetten.......	1910	1909	No	Cured	

TABLE III.—INVAGINATION OF SAC.

No.	Author	Operator	Date of Publ.	Date of Oper.	Leakage	Result	Remarks.
1	Girard.......	Girard.......	1896	1895	Yes	Cured	
2	Girard.......	Girard.......	1896	1896	No	Cured	
3	Starck.......	Czerny.......	1901	1900	Yes	Cured	Also plastic.
4	Halstead.....	Halstead.....	1904	1903	No	Cured	

TABLE IV.—EXCISION OF SAC IN TWO STAGES.

No.	Author	Operator	Date of Publ.	Date of Oper.	Leakage	Result	Remarks.
1	Goldmann....	Goldmann....	1907	1907	Yes	Cured	Also strumectomy.
2	Goldmann....	Goldmann....	1909	1908	Yes	Cured	

TABLE V.—DESTRUCTION OF MUCOSA OF SAC.

No.	Author	Operator	Date of Publ.	Date of Oper.	Leakage	Result	Remarks.
1	Gehle........	Gehle........	1907	1905	Yes	Cured	Stomach tube into œsophagus, sac twisted and ligated on tube and opening of sac sewed to the skin.

PRELIMINARY TREATMENT.

General.—The nutrition of the patient should be brought to as high a plane as possible, if necessary by tube feeding, by nutrient enemata or finally by gastrostomy feeding, which I shall discuss later. The upper part of the alimentary canal should be rendered as clean as possible by the institution of a thorough course of oral hygiene. The teeth should be put in good order, they should be thoroughly cleansed and kept so, the tongue should be scraped and an antiseptic mouthwash should be used frequently for several days prior to operation, while the patient should be urged to drink large quantities of sterile water. No food should be taken *per os* for some time before the operation and if the sac contains stagnated food, this should be washed out. Just previous to operation morphin in combination with atropin should be given hyperdermatically. The latter not only stimulates respiration and counteracts the unfavorable effect of morphin upon this function during anæsthesia, but also prevents cardiac inhibition from the anæsthetic or pharyngeal stimulation, and decreases the secretion of mucus in the throat. Chloroform or a chloroform mixture is preferable to ether as the anæsthetic in these cases, as it insures a quieter narcosis, induces less secretion of mucus and is less likely to be followed by pulmonary complications, which last must be carefully guarded against as the patients are usually of advanced age and of deficient vitality.

Gastrostomy.—Though not generally advocated, I believe that a preliminary gastrostomy is very desirable, especially if the patient is very much underfed. As de Quervain, Helferich and v. Hacker have pointed out, this simple operation, which to-day can be done so safely even without a general anæsthetic, greatly diminishes the risk of pharyngeal and œsophageal surgery. It certainly permits of much more thorough previous disinfection of the upper digestive tract and solves the problem of subsequent feeding, thus eliminating the main danger of the operation, periœsophageal phlegmon and posterior mediastinitis. It accomplishes very much the same purpose that a preliminary colostomy does in an excision of the rectum. To be sure, 1 of the 5 cases in which this plan was adopted died, making the mortality percentage even higher than in that group where direct excision was practised, but the number of cases with preliminary gastrostomy is too small, comparatively, to justify statistical conclusions, the case was operated before our modern surgical era and the cause of death was probably due to bichloride poisoning and avoidable. At any rate, I certainly believe that primary union of the œsophagus would be much more frequent if a gastric fistula were present, and I am convinced that my patient would never have had such an uneventful convalescence without his gastrostomy, which, of course, in this particular instance, was performed originally with a different object in view.

OPERATIVE TECHNIC.

Exposure of Sac.—A free incision along the anterior border of the sternocleidomastoid, running from the hyoid bone to the jugulum, is the best method of reaching the diverticulum. As these pouches usually lie a little to the left of the median line, a left-sided incision is preferable, but should there be reason to believe that the sac is right-sided, one must, of course, enter the neck from that side. After dividing the platysma one enters the line of cleavage between the omohyoid and sternohyoid muscles and finally divides the middle layer of the deep cervical fascia, internal to the carotid sheath. The vessels and pneumogastric are then retracted laterally with the omohyoid and sternocleidomastoid muscles. These muscles, particularly the former, may be divided if more room is required. The larynx, thyroid gland, sternohyoid and sternothyroid are retracted medially. The recurrent laryngeal is pulled inward and forward by this retraction, is easily avoided and is usually not seen. If this inward retraction is not ample and greater exposure is necessary the inferior thyroid or superior thyroid vessels or both may be ligated and divided. Should a struma be present this can be excised, which procedure not only renders the sac more accessible but also removes one of its predisposing causes. This has been done three times. The sac is now readily brought into view behind the œsophagus and one is prepared to take steps to remove it. Should the identification of the sac prove difficult, this may be facilitated by the introduction of a bougie into the œsophagus, into the sac or into both.

Treatment of the Sac.—After the sac is once exposed the development of it is a comparatively simple matter and can easily be accomplished by blunt dissection. Opening of the pleura, injury to the thoracic duct or to the junction of the subclavian and internal jugular veins are more theoretical than actual dangers and are easily avoided. It is astonishing how deep one can reach into the thoracic cavity from this cervical wound. I have found in a number of cadaver dissections that one can with ease gain access to a point at least 25 centimetres from the teeth. If need be one can grasp the sac with a blunt forceps and thus pull it out. It now merely becomes a question of the best method of excising the sac and of handling the stump and the œsophageal wound. I do not believe that the methods of Goldmann and Gehle require serious consideration. They have been devised to increase the safety of the operation, which end can be accomplished by means other than those that do not belong to the realm of clean-cut surgery. In my opinion the simplest and most aseptic plan is to directly resect the sac very much in the same manner in which the appendix is removed, namely by dividing the neck of the diverticulum with the cautery between a stout catgut ligature applied close to the œsophagus and a clamp applied distally. The stump should be thoroughly cauterized to disinfect it and destroy the mucous membrane, and before the ligature has been cut a purse-string non-penetrating catgut suture of the submucosa may be inserted around it. The stump can then be inverted and a double layer of interrupted catgut sutures should be applied longitudinally to close up the muscularis over it. This corresponds somewhat to Kocher's procedure. If the application of a ligature is not feasible owing to the thickness of the neck of the sack, one might simply resect the sac near the œsophagus with a scissors and make an attempt to close completely the œsophageal mucous membrane by interrupted catgut sutures about as v. Bergmann proposed. I cannot indorse the plan used several times of inserting a stomach tube or catheter into the open or partly closed œsophagus for feeding purposes. There might perhaps be some justification for this scheme where a large ragged hole is left in the œsophagus, attempts at closing which either fail entirely or are only partially successful, but, in general, one should certainly strive for complete closure. If one discovers a stricture below the pouch this should be divided (Brewer) or a plastic can be done on the principle of the Heinecke- v. Mikulicz pyloroplasty (Richardson, Czerny).

One word in reference to the Girard operation, the invagination of the sac without opening it. This certainly diminishes the danger of infection but is only applicable to very small sacs and even in such cases is by no means ideal. It leaves a polypoid mass in the œsophagus and the possibility of leakage is not absolutely excluded. A fistula developed in 2 of the 4 cases presumably from the stitch-holes of the closing suture.

Whichever method of treating the sac and the wound in the œsophagus is used free drainage by gauze or cigarette drains leading to the retroœsophageal tissues and to the wound itself must be provided to insure against leakage, which is an ever present possibility. The drains are led through the lower part of the wound and the upper portion is sutured.

AFTER-TREATMENT.

Unless a preliminary gastrostomy is present the after-treatment is complicated by the feeding question. With a gastrostomy the patient is fed through the fistula as soon as he has recovered from the effects of the anæsthetic and is given nothing *per os* for at least five days, after which sterile water with or without whiskey may be administered. At the end of a week the patient may have all liquids and then the diet may be gradually increased to full within the next four or five days. The patient should also be urged not to make any efforts at deglutition, even of saliva. Without a gastrostomy the best plan is to rely upon nutrient enemata for three or four days, after which this may be supplemented gradually by mouth feeding. Unless the patient's nutrition is very much below par I would counsel dispensing with the stomach tube from above. Stimulants and saline should be given hypodermatically as indicated.

An antiseptic gargle, a tooth-brush and a tongue-scraper should be used frequently. The patient should be instructed to breath deeply, should be given the James bottles if necessary, and should be encouraged to expectorate. He should be sat up in bed as soon as he is conscious and should be out of bed after forty-eight hours. Codein or morphin may be given for his pharyngeal cough and atropin to stimulate respiration and keep the throat dry.

The local treatment of the wound should be along the lines of general surgical principles. The drains may be loosened on the third day and changed on the fifth to the seventh. Then the drainage opening may be allowed to heal. If a leakage develops, this will usually close spontaneously in time, or cauterization may be employed to assist closure.

In from ten days to two weeks one may attempt the careful passage of an œsophageal bougie. A large size, from No. 36 to No. 40 French should be used. This sounding should be repeated at first every few days and then at gradually increasing intervals till it is done only every few months.

When one is convinced that the condition of the œsophagus is absolutely satisfactory, the gastrostomy tube may be removed and the gastric fistula allowed to close. This it will do of its own accord if the Kader or Witzel method has been used, though the nitrate of silver stick or the Paquelin may be needed to hasten the closing.

The writer feels confident that, if close attention is paid to the details emphasized above, the operation for the radical extirpation of pharyngoœsophageal pressure diverticula will be brought into the domain of safe and successful surgery and that not only will the mortality be reduced to an unappreciable minimum but the patients will also be entirely cured of their distressing and dangerous condition and this, in the large majority of instances, by primary union.*

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* Since the completion of the above paper an article has appeared by Kaufmann and Kienböck,[62] in which another case of diverticulum is described that died four days after operation, and reference is made to a demonstration of v. Eiselsberg[63] who presented three cases which he had operated upon, of which two recovered and one died of an acute mediastinitis. In none of these last three was an exact suture of the œsophagus attempted, hence leakage can be assumed, and in one it is definitely stated that a small drainage tube was inserted into the œsophagus wound.

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INVESTIGATIONS CONCERNING THE TECHNIC OF LUNG RESECTION WITH THE APPLICATION OF BOTH FORMS OF DIFFERENTIAL PRESSURE.

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The operative removal of portions of the lung was first suggested by the well known experiments of Gluck, Schmidt and Biondi. Their investigations were followed by attempts to remove the lung apex in patients affected with beginning tuberculosis, with the hope of producing cure by the radical removal of the seat of the disease (Tuffier, Doyen, Lowson, Sonnenburg). This procedure does not harmonize with our conception now of an operative indication, and is therefore not employed, but it has shown that resection of lung tissue is possible and the operative removal of larger portions of the lung for neoplasm has since developed.

Two difficulties present themselves in the execution of a lung resection—the treatment of the operative wound of the lung, and, in certain cases, the prevention of pneumothorax.

The use of differential pressure enables us to obviate with certainty the dangers of lung collapse.

The extirpation of the larger chest wall tumors with lung

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* I would express my gratitude to Geh. Friedrich and Prof. Sauerbruch for their courtesy to me; also my indebtedness to the Surgical Department of the Harvard Medical School for the opportunity of going to Germany.—S. Robinson.

involvement has been most frequently the occasion for the removal of greater or less portions of lung tissue (Rehn, Bardenhauer, Konig, Garre, Trendelenburg and others). Ordinarily the lung has been sutured to the wound in the chest wall with packing of the wound surfaces. The experimental investigations concerning lung resection and lung suturing by Schmidt, Garre, Talke, Tiegel, Friedrich, Robinson, and Danielson, have taught us to recognize that primary suturing of the lung tissue is to be preferred. These writers recommend for the handling of lung wounds, certain simple and reliable methods, which have justified their existence. Large portions of lung tissue, in cases of primary lung-carcinoma, thus were removed successfully by Kuttner and Sauerbruch. Up to the present time the extirpation of complete lobes has been executed in but very few cases. The well known case of Helfrich, in which two complete lobes were removed, has remained the only case of this nature. The patient died seventeen hours after the operation. Both Haidenhain and Murphy have since extirpated a lower lobe, but with poor results. Garre was fortunate in the successful extirpation of a bronchiectatic lower lobe, having previously placed it in front of the chest wall. Friedrich, with the use of the differential pressure method, removed two bronchiectatic lower lobes. In both cases, after a favorable course of five days, the closure of the bronchus gave way, and the patients died with tensionpneumothorax.

In animal experimentation the investigations concerning the removal of entire lung lobes are far more numerous. Here again the experiments of Gluck, Schmidt, and Biondi are the foundation. Experimenters have successfully extirpated lobes of lungs in dogs, in fact some of the animals have withstood the total removal of one lung.

In recent years these original experiments have been undertaken again in increased numbers. The extirpation of lung lobes was the operative procedure by which the method of differentiatial pressure was worked out and established. Such were the original experiments in the pneumatic cabinet in

Breslau, where a large number of animals were operated. Later Tiegel, L. Mayer, Friedrich, Robinson, and Danielson, worked out the operative technic of lung operations, especially the amputation of complete lobes. All these operators succeeded in the removal of single lobes without the subsequent death of the animal. Quite different were the results in the extirpation of a complete lung. All who have performed this operation agree that the removal of a complete lung is technically easily accomplished and that the immediate danger under the use of the differential pressure method is very slight. Quite unlike are the end results. L. Mayer reported 15 fatalities in 17 complete extirpations of the lung in dogs. Robinson had 12 deaths in 15 dogs. His results with rabbits were considerably more favorable. Green has also a very high mortality. Much better results were accomplished in similar experiments by Tiegel and Sauerbruch at Breslau. Exact figures of their mortality are not at our disposal, but it may be said that only a few animals failed to withstand the removal of one lung. Friedrich, who performed many such operations in dogs in Greifswald, lost but few animals.

The cause of death after the extirpation of a complete lung may vary considerably. The animals rarely die as an immediate result of the ligature of the hilus vessels or of the bronchus. Tiegel, who refers particularly to this point, explains such death by a reflex stimulation of the vagus branches lying in the region of the hilus. This rational explanation would lead us to undertake the treatment of the bronchus and the hilus vessels in the human as far from the mediastinum as possible. Other animals die within the first three days from an infection induced by the operation. We recognize this clinically by the indications of fever, general exhaustion and the formation of exudate. At autopsy, cause of death is shown to be a severe suppurative, fibrinous pleuritis, with extensive thick liquid exudate which is frequently hemorrhagic. A third group dies from the sixth to the eighth day, seldom later. In these cases a slow increase in the circumference of the body occurs. At the same time the dogs show difficulty in breathing, which finally develops into marked dyspnœa. Here likewise the autopsy findings offer sufficient explanation of the cause of death. One usually finds an extensive skin emphysema, and a marked inflation of the mediastinum with air. The diaphragm is pushed well over toward the side of the unoperated cavity, and with it the heart and vessels which are not infrequently found kinked. The bronchial stump is retracted into the mediastinum; its lumen is no longer closed, but gapes more or less. Death occurs here in consequence of so-called tensionpneumothorax and mediastinal emphysema. Both are caused by the escape of air from the improperly treated bronchus. The more exact pathology of this condition, which is so important in practical surgery, was described in detail by one of us about a year ago.

Infection or tensionpneumothorax were the only causes of death in connection with the removal of a complete lung which were to be considered in the experiments performed at Breslau and Greifswald. Friedrich declares that his animals failed to withstand the removal of a lung only when the bronchial suture leaked, or when an infection occurred in the pleural cavity.

With a very careful asepsis carried out to the last detail (which is difficult in the dog), the infection of the pleural cavity may be avoided. The tensionpneumothorax cannot exist if the bronchial stump is carefully treated. But here we come to a crucial point in lung surgery. Every one who has worked in this region has admitted the difficulty of this task. Some operators—Garre, Tiegel, Friedrich, and Danielson—have successfully performed and established a reliable technic for treatment of the bronchus. The closure of the latter consists in a particular handling of the stump. Excochleation or cauterization of the mucous membrane with subsequent suture of the peripheral bronchial lumen, numerous ligatures of it, suturing the lung or mediastinal tissue over the stump—all these are methods which point to progress. But even better than these procedures appears that which Willy Meyer has employed in his experiments. Meyer treats the bronchial stump of the lung in the same manner as the stump of the appendix in appendectomy. By crushing of the cartilage at two points he softens the distal portion of the bronchus, thus rendering it flexible. By folding in and suturing he obtains a positive and lasting closure. The outcome of this method proves its practicability. Of 17 dogs in which he performed a total extirpation of the lung he lost but one.

Finally, there is to be mentioned a special cause of death, to which Robinson first called attention, which had remained unknown to all who have extirpated the whole lung under negative pressure. Robinson states that in connection with the removal of the complete lung there regularly exists a marked exudation in the pleural cavity, which usually leads to death on the third or fifth day. Our experiments together, all of which have been performed under positive pressure. have confirmed this observation throughout. Similarly, as in the animals with tensionpneumothorax, a dyspnœa of marked degree appears some days after the operation. The animals soon become exhausted. Respiration and heart rate are accelerated and with symptoms of marked, continually increasing dyspnœa they generally die between the third and fifth day. At the autopsy a marked bulging of the operated side is noticeable. The entire pleural cavity is filled with a clear or slightly cloudy serous fluid; the heart and mediastinum are pushed to the other side and the other lung compressed. This transudate, which differs perceptibly from an infectious exudate by its clear egg-white and sterile character, must be regarded as a cause of death. It encroaches upon the heart and its vessels and compresses the other lung. The animal dies of a mechanical hinderance of the heart action, blood circulation and respiration. These are definite explanations for the origin of this transudate.

After the removal of one lung the considerable emptied space of one whole pleural cavity remains. From Tiegel's work, "Experimental Lung Surgery," and Friedrich's investigation about the consequences of total extirpation of the lung in animals, we know that a complete compensatory occupancy of the space takes place after the lung extirpation. The pleural cavity becomes smaller, because the walls approach one another and finally become approximated. The thorax wall sinks in, the diaphragm is elevated, the lung of the unoperated side expands, thereby displacing the heart and vessels towards the caving thorax wall. Finally the heart and vessels essentially fill the operated side of the thorax wall. Since the above changes occur in the absence of inflammatory changes, we may recognize them as a functional adaptability of the organism to its new conditions (Friedrich). Autopsies of animals which have died soon after the operation have shown that this gradual displacement of organs commences immediately after the removal of the lung. We observed a marked diminution in the size of the cavity at the extirpation of twenty hours. In young animals with soft ribs and flexible chest wall the pleural cavity was completely occupied after eight days. The surface of the pericardium lay close against the parietal pleura, so that there was no space between. In other cases this adaptation process lasts longer, and even after fourteen to twenty days more or less of a cavity will be found. The reconstruction is always completed at the end of four weeks.

Conditions are different when the displacement of the organs or the concaving of the chest wall is for any reason prevented. The rigidity of the thorax in older animals hinders considerably the contracture of the cavity. When the mediastinum cannot change its position in consequence of an inflammatory thickening, or if it is retained in its usual position for other reasons, a diminution of the size of the emptied cavity can occur but slowly,—indeed, if furthermore the chest wall, in consequence of the rigidity of the ribs is likewise fixed, an obliteration of the existing cavity becomes impossible. Under these conditions a marked transudate from the serous pleural surfaces begins to accumulate in the persisting cavity soon after the operation. The larger the cavity and the slower it diminishes in size the greater the accumulation of fluid. Then follows a greater increase of pressure upon the surrounding structures, leading eventually to a displacement of the heart and its vessels and a compression of the other lung. The effect of the transudate resembles on the whole that which we have recognized in human pathology as the result of the accumulation of quantities of fluid in the pleural space.

For the success of the lung extirpation everything depends upon the prevention of such an exudate,—in other words, one must see to it that the remaining cavity contracts as soon as possible after the lung extirpation.

The compensatory displacement of the organs which come in question here is essentially dependent upon two factors. First, upon their own elasticity and mobility; secondly, upon the relation of the pressure within the pleural space to that of its surroundings. The normal lung, the heart, and the mediastinum ordinarily assume the leading share in the task of filling up the cavity, while the unyielding thorax wall takes the least part in the diminution of volume.

The activity with which mediastinum, diaphragm, and lung press into the cavity is directly dependent on the difference between the pressure in the empty pleural space and that of the neighboring cavity (abdomen and intact pleural cavity). The most favorable conditions for displacement are present when given a very yielding thorax wall and mediastinal septum and the pressure in the empty pleural cavity is low. On the other hand, when the mediastinum has become stiffened by chronic inflammation and a positive pressure exists in the empty pleural cavity, a like displacement can hardly be expected. The thorax wall will best cave inwards when very flexible and coincident with low intrapleural pressure.

It should now be experimentally determined how the best conditions for a speedy diminution of the remaining cavity can be practically acquired. Twenty-eight dogs in all were operated by us. Furthermore, we have at our disposal the results of experiments by Dr. Haecker, who in the course of investigating another problem, performed total extirpation in thirty dogs.

The experimental animals were prepared in the following manner: An hour before the operation the dogs were given 1 cgr. of morphia per kilo of body weight. The skin of the entire left chest was shaved, thoroughly washed with soap and water, then rubbed dry with benzine. Otherwise the preparation was the same as for an aseptic operation in the human. Ether was used for narcosis.

In order to obtain useful comparative results, the left lung of the animal was invariably chosen for excision. The treatment of the hilus in all cases consisted of simple ligature. We have preferred these simple methods because they can be more quickly executed, and for our special investigation this part of the operation is of no special consequence.

Total extirpation was performed by three different methods. First, simple total extirpation through an intercostal incision with primary closure of the wound. Second, a double operation: transplantation of the entire lung upon the thorax wall with secondary amputation (proposed by Friedrich). Third, primary extirpation of the lung with simultaneous thoracoplasty (removal of several ribs).

SIMPLE TOTAL EXTIRPATION OF THE LUNG THROUGH INTERCOSTAL INCISION.

The technic of this procedure is very simple. The animal is placed on the right side; the fifth intercostal space is opened by an incision of about 15 cm., beginning at the scapula line. The lung is seized with the left hand, and gently drawn slightly forward. A silk ligature is then placed around the entire root of the lung, whereby both bronchus and vessels are ligated. Then follows the amputation of the lung distal to the ligature. The intercostal incision is closed by pericostal, muscle and skin sutures.

This technic, with the exception of a few trivial changes, was also employed in the early experiments at Breslau and Greifswald. But at that time all the operations were performed with the use of negative pressure, while these experiments were performed with a positive pressure apparatus.

Dr. Haecker performed extirpation of the lung, likewise employing a positive pressure apparatus. The complete number of experiments in this series, including those of Dr. Haecker, amounts to 38. Of these 9 died after six days, from leakage of the bronchus. Seven died of a primary operative infection. In 18 animals a marked accumulation of transudate occurred, causing death from the third to the fifth day. According to this only 4 of 38 withstood the procedure.

This poor result was in direct contradiction to our earlier experience in the same operation in the clinic at Breslau and Greifswald. If we deduct the animals which died from infection or tensionpneumothorax, 22 remain, of which 18 died, that is 82 per cent. In the earlier experiments under negative pressure, no causes of death other than infection and tension-pneumothorax came into consideration, and yet now 18 of 22 animals were lost. This high mortality corresponds with the results which L. Mayer, Green, and Robinson earlier obtained. From a final consideration we note the following striking factor, that there is a marked contrast between the results of those who performed total extirpation of the lung with negative pressure (Tiegel, Friedrich, Haecker, Willy Meyer, and Sauerbruch) and those who used the positive pressure apparatus (L. Mayer, Green, Robinson, Haecker, and Sauerbruch). On the one side a very low mortality, on the other a very high one.

We cannot explain these contradictory results on the basis of differing technic inasmuch as the same operators obtained contradictory results when employing the two methods. It seems more rational to presume that the explanation is rather to be found in the choice of differential pressure method. We are further persuaded to this conclusion by the fact that a transudate was of common occurrence in the animals operated under positive pressure, while with negative pressure it was rarely present. We have already explained the effect of such a fluid accumulation. We must associate the early death of certain animals with the formation of transudate. The latter invariably occurs when after the removal of a whole lung the emptied cavity fails for any reason to diminish in size, and an unoccupied space persists. Why does the transudate arise in one case and not in the other? is a similar question to, Why does the pleural cavity diminish in capacity at one instance and not at another?

The diminution of the pleural space depends, as we have already observed, upon the flexibility and movability of the diaphragm, mediastinum, and lung. Furthermore, the existing pressure in the pleural cavity is of great importance in the displacement of these organs. In reference to the condition of the mediastinum and diaphragm, there is certainly no difference in the animals operated by the negative or positive pressure.

But there is a difference in the pressure conditions in the cavity which remains after the operation. Here we find a striking contrast, according as one or the other form of differentiating pressure was employed. In using the pneumatic negative pressure cabinet there exists after the closure of the chest wall wound the negative pressure which has remained in the pleural space during the operation; that is, there persists in the remaining cavity a diminution of pressure equal to the negative pressure in the normal pleural cavity. This reduced pressure facilitates the compensatory displacement of the organs which take part in the diminution of the chest cavity,—namely, the protruding of the diaphragm, the mediastinum, and particularly the lung which is now well distended. The lower the pressure is in this cavity so much the more favorable are the conditions for this compensatory encroaching of the neighboring organs. Slowly and gradually the chest wall, mediastinum, and diaphragm approach each other. As the persisting cavity becomes contracted, the conditions for transudate formation become more unfavorable. Finally, when the opposite surfaces are approximated, and the entire pleural space is obliterated, the accumulation of transudate is impossible.

The conditions are different after the use of a positive pressure apparatus. At the close of the operation, after the removal of the lung, the pressure in the pleural cavity is that of the surrounding air,—namely, one atmosphere. But as a negative pressure prevails in the unopened pleural cavity, the mediastinum is under less pressure from this side than from the other. A displacement of the mediastinum, in the sense of a diminution of the cavity of the emptied side, is thereby rendered much more difficult. For the same reason, a compensatory distention of the remaining lung towards the cavity, under the greater tension, is not possible. As long as the positive pressure apparatus is in effect, the lung and also the mediastinum can be pushed forcibly over to the operated side by increased intrabronchial pressure. But at the moment, when the effect of the apparatus ceases, the mediastinum must give way to the stronger load on one side, and again deviate to the opposite unoperated side. As the diaphragm must also overcome the prevailing positive pressure in the empty pleural cavity, it will not be able to exert its compensatory activity completely. Here we are confronted by the conditions of the total closed pneumothorax. The great difference rests in the fact that in simple collapse of the lung we have a large reabsorbing surface in the intact lung, which of course is lacking after excision. Following extirpation, therefore, the air in the remaining cavity is absorbed far less readily. We will refer elsewhere to the reabsorption of air in the pleural cavity.

Considerable time will elapse before the greater portion of the air has disappeared; the positive pressure is no longer present and the lung and diaphragm are displaced and the diminution of the cavity can begin.

During this interval a marked transudate will have begun to accumulate in the cavity, and this fluid in turn hinders the diaphragm and mediastinum in their encroachment. As the accumulation of fluid increases its pressure is magnified and the diminution of the cavity is attended with greater difficulty. Finally, we can see that by too strong a pressure upon heart, vessels, and the remaining lung, death itself may occur.

It may be said, therefore, that with the use of negative pressure the conditions after lung extirpation are very favorable for a prompt diminution in the capacity of the remaining cavity. Resultingly, a transudate cannot occur except in very slight degree. On the contrary, with the use of positive pressure the increased pressure in the emptied pleural space opposes the migration of the mediastinum in that direction. Reduction in the size of this space therefore is hindered. Instead of a compensatory displacement of the neighboring organs the cavity is filled with a collection of fluid.

The difference in the results of the several experimenters is explained by this simple consideration. It depends directly on the different conditions of pressure which persist in the pleural space after the operation, according to the form of differential pressure which has been employed. The good results obtained with the use of negative pressure are ascribable to the rapid contracture which follows its uses. The death of the experimented animals operated under positive pressure is caused by the pressure of a transudate which exists in the unaltered pleural space. Here, furthermore, we must add that secondary infection is to be considered—in some cases—in addition to the mechanical effect of the transudate. We are well aware how readily such transudates become infected and are especially eager to avoid their occurrence after operation.

It may be argued that in the use of the positive pressure method we have the best means for avoiding these disturbances. If, with the help of the positive pressure apparatus, the intrabronchial pressure is so raised that the normal lung is inflated above normal, then it presses over into the emptied cavity, taking with it both heart and mediastinum. In this manner, to be sure, as many experiments have demonstrated, practically the entire cavity can be obliterated. With sufficient increase of pressure, the diaphragm will move as far as the inner surface of the chest wall, so that the stump of the hilus will lie in the thorax wound. If the chest wall is closed with the lung in this distended condition only a small cavity remains. As soon as the effect of the positive pressure ceases the lung retracts in consequence of its elasticity, moving simultaneously with the heart and diaphragm towards the other pleural cavity, thus separating itself from the chest wall. Thus the cavity becomes larger, the enclosed quantity of air occupies a larger space, and its pressure becomes negative. In this manner one may create conditions similar to those established from the beginning by the use of the negative pressure method. It must be admitted that in this way the unfavorable pressure conditions which have remained after the use of the positive pressure method can be artificially obviated. But the acute over-distention of the lung which is necessary for this is not without danger. In order to obtain sufficient displacement an increase of pressure of 10 to 15 mm. above the average pressure of 7 to 8 mm. Hg. is necessary; which means for the interior surface of the lung a weight of about 20 mm. This is not without moment to the circulation of the lung. The increase of pressure in the alveoli means a compression of the vessels. The resistance magnifies, and the work of the heart is decidedly increased. Tiegel was able to prove experimentally that such an over-extension of the lung is ill borne, that it may lead to dyspnœa, and probably favors postoperative embolism. In the gradual displacement of the lung and mediastinum we need not fear such disturbances, because heart and lung have sufficient time to accommodate themselves to the new conditions.

These experimental results are of certain importance in practical surgery. We shall hardly arrive in a position to remove the entire lung in the human, and the diminution of the remaining cavity by the compensatory displacement of the neighboring organs will be as conspicuous a factor as in animal experiments. But what we have observed in the most extreme form after the removal of an entire lung in our animal experimentation, occurs also in a less degree when only a single lobe or smaller sections have been removed in continuity. There can be no doubt that the space which remains after the extirpation of a single lobe diminishes more readily when by a decrease of pressure the encroaching of the surrounding organs is favored. This factor seems of importance in surgical practice, because we are thus more justified in omitting the packing of the cavity than under other conditions. Tamponage usually leads to infection, and is therefore to be avoided. This distinction which has been found between the two forms of differentiating pressure is of much more importance than all other theoretic conditions hitherto presented.

THE EXTIRPATION OF THE LUNG WITH SIMULTANEOUS THORACOPLASTY.

An important condition for the compensatory encroaching of the mediastinum, heart, and lung, is a sufficient mobility of these organs. Wherever chronic growths and thickening of the mediastinum are at hand they cannot contribute in the diminution of the remaining cavity. In practical surgery, therefore, in which we have frequently to consider the condition of the mediastinum, the question is of importance, how we can provide for the failure of the compensatory displacement of the heart and lung. Such a pleural space, with an immovable mediastinum, persisting after the removal of a lung, resembles an old empyema cavity. From this, one thinks at once of diminishing the cavity primarily by an operation. One might, after the removal of the lung, mobilize the chest wall by rib resection and transplant it inwards upon the mediastinum. In several experiments of extirpation of the lung we have combined a more or less extended thoracoplasty. Inasmuch as these operations were performed with a positive pressure apparatus, a participation of the mediastinum in the diminution of the remaining cavity could not come into consideration, as we have just seen. As regards this element, the same conditions existed as if the mediastinum had been immobilized by inflammation. After making a skin-muscle flap with a wide base extending over the complete left chest wall to the lower arch, the ribs were freed from the third to the last.

Through an intercostal incision in the sixth intercostal space, the intercostal artery was now ligated with a pericostal suture about 15 cm. removed from the sternal edge. Then the rib was cut just anterior to the ligature, and at the costosternal articulation the attached intercostal muscles were reflected upwards, and in the same manner the next following rib separated. In this manner three or four ribs with their intercostal muscles were excised from the chest wall. From this window the complete lung could be conveniently extirpated. The large flexible skin-flaps were accurately laid in the trough of the pleural space, the edges being sutured according to its former position. As soon as the lobe was sutured it bulged with each expiration, only to be drawn in again at the next inspiration. The flap was pressed against the mediastinal pleura by means of a cotton bolster and fixed to this portion with a binder.

Twelve animals in all were operated by this technic. Two ribs were excised in six dogs, four were removed in two, and six and seven ribs in the remaining four cases. Five of the first six dogs died, only one withstanding the operation. The cause of death, just as in the cases in which a lung was removed under positive pressure, was a considerable accumulation of fluid in the pleural cavity, with displacement of the mediastinum towards the sound side and with downward displacement of the diaphragm. In the region of the excised ribs the soft tissues of the chest wall were caved in.

We have learned to recognize the accumulation of transudate as a direct result of the absence of contraction of the chest cavity. We must, therefore, consider that the removal of two ribs only was not extensive enough to provide for a sufficient contracture of the pleural cavity. Of the two animals from whom four ribs were resected, one is living, the other died on the fifth day. The skin stitch was not tight; air pressed under the flap, pushing it away and bringing about a pneumothorax on that side. Death occurred about an hour after this leakage. At autopsy the pleural cavity was found to be already somewhat diminished in size and absolutely free from fluid.

From these animals in which the chest wall was extensively mobilized by the removal of from six to seven ribs, only two survived. The others died within the first twenty-four hours after the operation with signs of marked dyspnœa. Furthermore, both of the surviving animals had shown signs of dyspnœa, which lasted to the second day; but it had disappeared almost completely on the third day. This serious hindrance to breathing which came on in all the cases is a direct result of depriving the chest wall of its bony elements. The flabby, yielding skin and muscle flap which after the operation lay directly on the mediastinal pleura, is no longer in condition to withstand the atmospheric pressure which is expended upon it, namely, the yielding displaceable mediastinal pleura. Exactly as in an open pneumothorax the mediastinum is pressed over into the unoperated side so that a laboring of the heart action, a kinking of its vessels and a compression of the sound lung must ensue. This observation agrees throughout with that of Robinson and Eden in their extensive thoracoplastic resections in dogs. The mechanical displacement of the mediastinal septum after the removal of the bony chest wall with its irremedial effect on heart and great vessels and the opposite lung, is demonstrated also by clinical experience.

In the human, after the Brauer-Friedrich operation, there occurs in the first place marked dyspnœa and a weakening of the heart action, which under certain conditions may endanger the life of the patient; in fact, it has indeed proved fatal. The explanation is to be found in this fluttering of the mediastinal pleura after the removal of the bony chest wall.

Naturally, if the mediastinal pleura has become thickened and unyielding with chronic inflammation, and can withstand the pressure from without, we need not fear the above complication (see the works of Brauer and Friedrich). The experiments show in the first place, that no marked diminution in the size of the pleural space comes on in dogs if only two ribs are removed. The accumulation of fluid in the pleural cavity is therefore not prevented. The mobilization of the chest wall to a greater extent, which makes it possible to obliterate the whole pleural space, through the displacement of the skin and muscle flap into the cavity, prevents the accumulation of transudate fluid but has an unfavorable effect, because it is displaced with pressure on the mediastinum. The most favorable procedure was the removal of four ribs. The pleural cavity was so much diminished in size that a transudate could no longer accumulate, and, furthermore, a displacement of the mediastinum by the outer atmospheric pressure could not occur. Therefore we can accomplish the obliteration of the pleural space and the prevention of transudate by mobilizing the chest wall, pressing it into the pleural space, in this way obliterating the cavity, or perhaps only diminishing its size. The extent to which the excision of ribs may be carried depends on the condition of the mediastinum. In the presence of a thin movable mediastinum the total removal of the bony wall is very dangerous, and one must be satisfied under such conditions with the excision of four to five ribs. If, on the contrary, the mediastinal pleura is thick, strong, and unyielding, then the dangers which are to be associated with its displacement are not to be feared. In this case, after the extensive deossification of the chest wall the skin and muscle flap can be laid in the pleural cavity without danger, completely obliterating the space, thereby completely preventing the formation of transudate and providing the best conditions for healing.

THE TWO-SITTING OPERATION. TRANSPLANTATION OF THE LUNG.

The experiments given here were the result of a practical necessity in certain cases of avoiding a primary treatment of the bronchus by suture or ligature. If its wall is diseased or inflamed, or if incision into the pleural cavity is rendered dangerous by an infectious content, it is better to avoid the primary treatment of the stump. The bronchus or the whole lung root is stitched to the chest wall, so that in case of later leakage there would be no escape into the pleural cavity. In this way the lung can be primarily or secondarily removed. It was important to determine which is the preferable method, and also what may be the after effect on the cubical contents of the cavity resulting from the stitching of the bronchus to the chest wall.

The operations were conducted in the following manner: First, the thorax was opened in the fifth intercostal space by an intercostal incision, the animal being in the right lateral position. In order to deliver the lung upon the thorax wall, the distance between the lung-hilus and the chest wall opening must be diminished. We accomplished this in one case by resecting one or two ribs above and below the chest wall incision, so that this part of the thorax could be easily pressed in.

In a second instance, by a slight traction on the lung root the mediastinum was drawn into the pleural cavity of the operated side. The displacement was thus rendered easier. The root of the lung was fixed to the soft parts in the external angle of the chest wall incision by sutures including only the wall of the bronchus. The soft parts were laid around it and sutured together, so that a tighter closure was secured. We did not ligature the vessels of the lung hilus in order to retain the circulation to the transplanted lung. Several times tearing of the vessels and disturbances of circulation occurred in consequence of the extreme tension. Immediately after the transplantation of the lung we noticed constantly that the pinkish red color of the lung became darker and the consistency firmer. The outer surface became wrinkled and no longer presented its normal smooth reflecting character. At the closure of the operation the transplanted lung was packed in sterile gauzes and covered loosely with a bandage. Six dogs were thus operated, but with very poor results. Only one dog lived long enough for the removal on the third day of the transplanted lung, and even this animal died in the near future. In four dogs, immediately after the suturing of the bronchus, the lung was removed. These animals also died on the second day. At autopsy we invariably found the lung very much swollen, of a doughy consistency, the surface moist and fibrinous. The dressing was saturated with exudate which had been thrown off the lung surface. Once the transplanted lung, as a result of marked tearing of the vessels, became gangrenous. In four animals, in which the lung was removed at the time of the ligature of the bronchus, death occurred in the same manner.

The appearances in the pleural cavity were of particular significance in the autopsy findings. In none of our cases were either transudate or exudate present. The pleural space, two days after the operation, was found reduced to a small crevice, and the mediastinum, at the level of the lung hilus, rested against the inner surface of the chest wall. In the animal which lived up to the third day, the lung was green and gangrenous when the bandage was changed. It was amputated in sound tissue in the region of the hilus and the bronchial stump was closed by suture. In consequence of manipulation the fixation stitches of the bronchus were torn away, the hilus stump and vessels retracted, carrying with them the mediastinum, and a corresponding quantity of air followed after. Animal died two days later. An extensive exudate of a clear serous consistency was found in the pleural cavity. We have here an important corroboration of our earlier observations. Together with the displacement of the lung, the mediastinum, after the excision of two ribs, approximates itself somewhat towards the chest wall,—furthermore, by the fixation of the lung hilus to the chest wall the mediastinum is quite markedly drawn over. Both factors result in a marked diminution in the cavity remaining after the lung extirpation. No transudate can occur, because the conditions which favor it are lacking. In one case in which the fixed bronchus freed itself after the removal of the lung, the mediastinum became again movable, jumped back into its original position, and the air rushed into the pleural space through the open wound. Resultingly, the conditions were present in which the cavity could not diminish in size, and the formation of a transudate was made possible. In fact, it was found in one of these animals at autopsy. From these experiments we can first conclude, that on the whole the early diminution in the size of the pleural space after the removal of a whole lung is of great importance in the avoidance of a transudate. Just as this reduction in the pleural space can be accomplished by the displacement of the chest wall, as we have mentioned above, it can likewise result from the pulling over of the mediastinum. But this method possesses the same disadvantages as the artificial over-inflation of the lung by intrabronchial positive pressure. This forcible, sudden displacement of the entire mediastinum with the heart and its vessels is not to be disregarded. Probably the death of the animal can be traced to this. From these experiments we learn further that the lung withstands this displacement. Congestion of vessels and excessive exudates lead to disturbances of nutrition with resulting gangrene. The conditions are perhaps otherwise when the displaced lung is not possessed of its normal covering, but is embedded in inflammatory scar tissue and is entirely cicatrized. In one such case Garre has successfully accomplished the delivery and secondary removal of a bronchiectatic lower lobe in the human. But here likewise, the fixation of the bronchus to the chest wall is dangerous on account of the possibility of tearing the mediastinum with its accompanying disturbances. It is therefore advisable always to combine the transplantation with a thoracoplastic operation in order to lessen the distance between the lung root and the chest wall and thus to avoid traction on the mediastinum. Garre has also utilized this method.

The above experiments have practical bearing in the surgery of the human. They demonstrate that the removal of one lung, or a large portion of the same, can only be accomplished successfully when the cavity persisting after the operation is diminished in size as soon as possible, in order thereby to avoid the accumulation of a transudate. This reduction in pleural capacity is best accomplished by the crowding in of the neighboring organs. We have likewise been able to demonstrate under what conditions this displacement of organs is possible. The difference which has been emphasized between the positive and negative pressure methods deserves practical consideration.

An operative reduction in the capacity of the pleural space is possible through the mobilization and displacement of the chest wall. If the mediastinum become stiffened by chronic inflammation, the thoracoplasty which we perform may be an extensive one, without dangerous disturbances to the heart or remaining lung. It must be limited to the removal of a few ribs if the mediastinum is a movable one and easily displaced.

Suturing the bronchus to the chest wall, which in certain conditions may be indicated, must be done in such a way that tearing of the mediastinum is avoided,—that is to say, the chest wall must be approximated as nearly as possible to the mediastinum by means of the mobilization and displacement of the former.

FUNCTIONAL DIAGNOSIS OF RENAL DISEASE, ESPECIALLY BY EXPERIMENTAL POLYURIA.

BY EDWARD L. KEYES, Jr., M.D.,

OF NEW YORK.

THE tests of renal function are of two chief varieties. The tests without ureter catheterism and those with ureter catheterism. Among the former we may include all the old-fashioned tests of renal function: physical examination of the patient, investigation of his history and urinalysis of 24-hour specimens, and night and day specimens, especially with reference to crystals, pus, tubercle bacilli, etc.

In the second class are the tests commonly spoken of as renal functional tests, and requiring catheterism of the ureter, or intravesical separation of the urine. These again may be divided into three classes:

1. Routine analysis of the specimens obtained with special reference to quantity, quality (as indicated by urea, total nitrogen or freezing point), and microscopic examination of centrifuged sediment.
2. Elimination of substances artificially introduced into the circulation (methylene blue, phloridzin and indigo carmin).
3. Experimental polyuria.

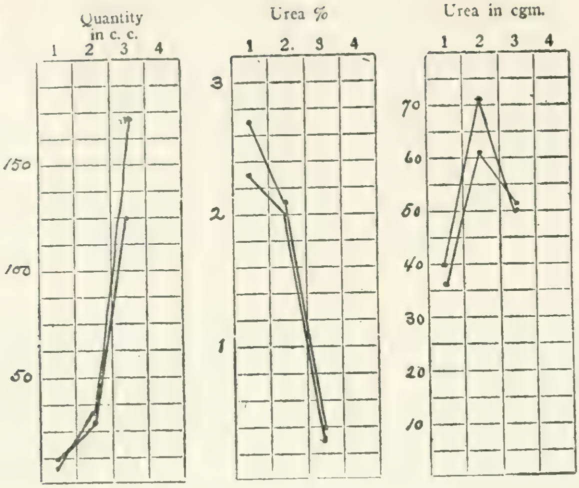
Of these three types of examination, the first is implied whenever the ureter catheter is employed. The question which arises is, whether we obtain any greater degree of accuracy by employing artificial elimination tests and experimental polyuria or not? To answer this question as far as I can is the object of this contribution. My investigations have borne chiefly on experimental polyuria.

Artificial Elimination.—For artificial elimination I have chiefly used phloridzin, injecting 1 c.c. of a 1 per cent. solution in 33 per cent. alcohol. In a few cases I have injected 3 or 4 c.c., of a 10 per cent. solution indigo carmin. The indigo comes through the kidneys with apparently the same regularity as does the phloridzin, and seems preferable, since it requires no chemical analysis whatever and, therefore, does not waste the urine or introduce any element of confusion in quantitative analysis. Hæmaturia obscures the indigo, however, and therefore in the presence of marked bleeding phloridzin is preferable.

That phloridzin demonstrates, as Kapsammer and others allege, the precise functional activity of the renal epithelium more accurately than any other substance artificially eliminated, may be theoretically true, but does not appear in practice. I have found it totally misleading if taken as an absolute criterion. I have had the experience of other surgeons in performing successful nephrectomy for tuberculosis of the kidney upon a patient in whose combined urines phloridzin did not appear for two hours. I have noted total absence of phloridzin for an hour and a half in a patient both of whose kidneys seemed entirely normal (Chart II). I have noted in another tubercular patient that while 2 c.c. of 1 per cent. injected phloridzin appeared in the total urine in two and a half hours, 1 c.c. appeared only in four hours; and yet operation revealed that one of this patient's kidneys was in fair condition. On the other hand, in Dr. Watson's case (Chart III) the right kidney gave glycosuria in 14 minutes and the left in 17. This was a most astounding showing with so manifest a debility of the left kidney.

In other words, the elimination tests are not a precise indication of the anatomical condition of a kidney. But in comparing the two kidneys to each other, these tests are sometimes of the greatest value. That one kidney shows phloridzin glycosuria in 15 minutes, while its fellow shows it only after 30 or 45 minutes, does not mean either that one kidney is perfectly sound or that its fellow is utterly diseased; it simply means that the kidney that first excretes phloridzin sugar is in better condition than the one that excretes it later: how much better must be determined by other tests.

CHART I



At the end of 1st period drank .2.. glasses of water. and 15 c.c. of whiskey

Catheter in both ureter.s

Extra catheter flow no..

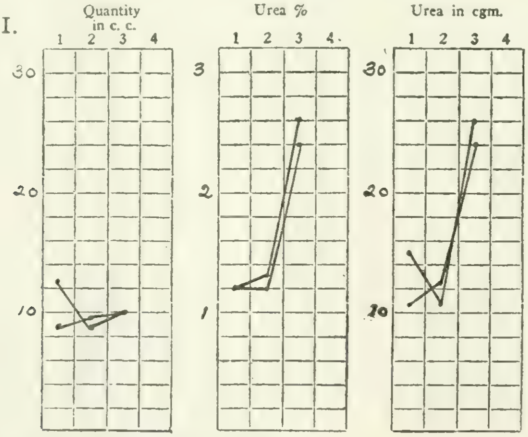
Microscopic Right Negative *

" Left ..".... " "

X-ray Negative

*As to abnormal elements all specimens contain more or less blood.

CHART II.



At the end of 1st period drank .4... glasses of water.

Catheter in T... ureter. 7

Extra catheter flow No..

Microscopic Right (Bladder)

" Left Negative *

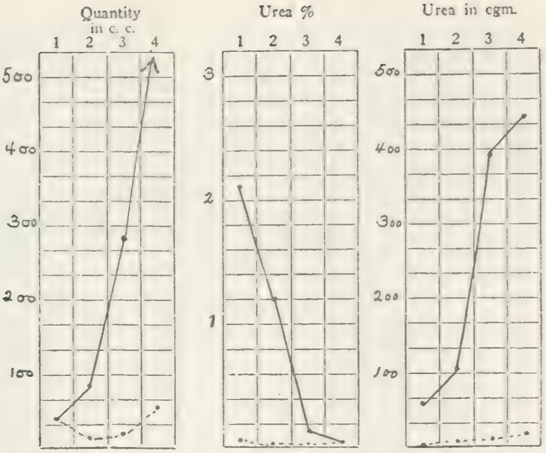
Phloridzin Right Not..in 1½hrs

" Left No...

X-ray showed pelvic shadows which styletted catheters proved extra uretral

*As per Chart I.

CHART III.



At the end of 2d period drank ...7... glasses of water.

~~Catheter in ...... ureter~~.

~~Extra catheter flow~~ ......

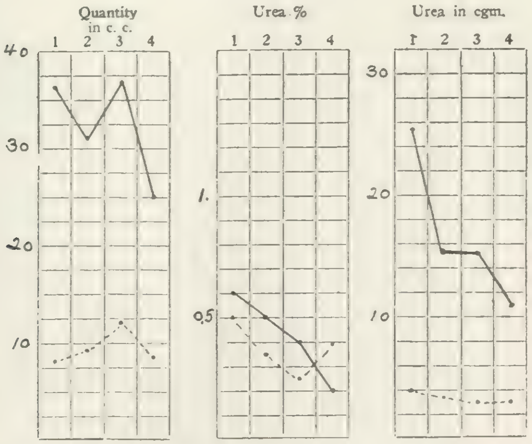
Microscopic Right Pus - Blood - Urates

Left " " "

Phloridzin Right 14 minutes

" Left 17 " " "

CHART IV.



At the end of 1st period drank 3... glasses of water

Catheter in Rt... ureter

Extra catheter flow No.

Microscopic Right Pus.

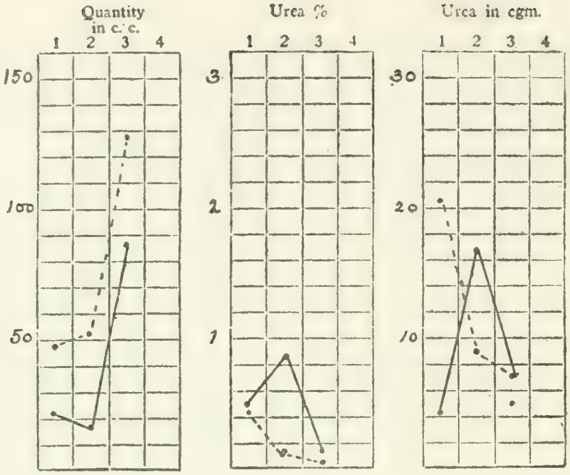
" Left Bladder

Golf hole rt ureter

Phloridzin Right None in 6 hrs

" Left " " " "

CHART V.



At the end of 1st period drank .3... glasses of water.

Catheter in Both ureter.s

Extra catheter flow No..

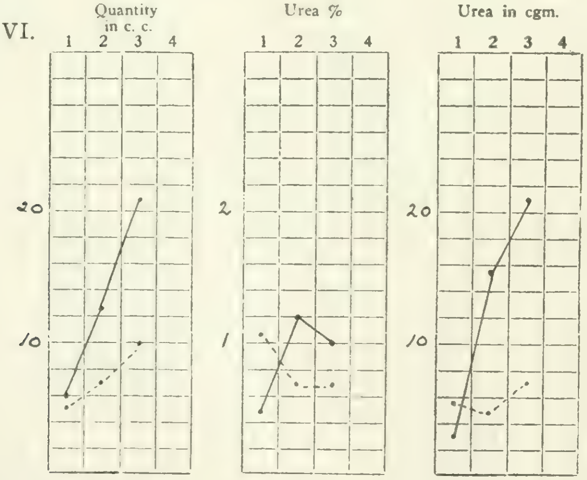
Microscopic Right Negative *

" Left "..." "

X-ray shows Stones

* As per Chart I.

CHART VI.



At the end of 1st period drank .3... glasses of water

Catheter in Both ureter.s

Extra catheter flow .No..

Microscopic Right Bacteria & pus

" Left "... " " "

*Experimental Polyuria.**—This method, which was introduced into urologic practice by Albarran, consists in taking a patient who has not eaten anything for at least four hours, or drunk anything for at least three hours, catheterizing the ureters and collecting the urine as follows: That passed during the first ten minutes is collected for microscopic analysis; thereafter the urines are collected by half hours. At the end of the first half hour Albarran administers two or three glasses of Evian water. He then collects separate specimens of urine for three consecutive half hours thereafter. Comparing these eight specimens among themselves he finds that by taking the quantity and quality (urea, nitrogen, freezing point) as a norm, during the second half hour (*i.e.*, immediately after the water has been drunk) the quantity of urine excreted by the normal kidney rises markedly, and this rise continues, or holds its own during the two succeeding half hours, or begins to fall off during the fourth. At the same time the quality of the urine deteriorates (urea percentage and $\triangle$), this fall being of course proportionate to the intensity of the polyuria, while the actual work done by the kidney, whether measured by centigrams of urea or by $\triangle$ volume, may increase or decrease. Plotting this out on charts he gets curves similar to those shown on Chart I. If both kidneys are normal their curves may be expected to run approximately parallel, although if the same two kidneys are examined at a subsequent period their parallel curves may be entirely different.

As an uncommon variant note Chart II. This chart was taken from a patient who suffered from abdominal pains and a very slight retention cystitis. Radiography showed pelvic shadows that were proven extra-ureteral by the stiletted catheter; and a few washes of nitrate of silver cured the cystitis. The urine obtained from the kidneys was normal, yet we note that in this case the experimental polyuria showed itself not by increase in quantity, but by increase in quality. The quantity remained the same; the urea percentage and the urea in centigrams shot up. In another case, almost the same in its physical characteristics, both the quantity and urea percentage increased (Case I).

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* These observations are founded upon thirty examinations. Some five or six of the cases were catheterized for me by Dr. B. S. Barringer.

We should run counter to physiologic fact in attributing this increase in urea percentage to the administration of water. On the contrary, this phenomenon simply shows that enough water was not administered to excite polyuria. The increase in urea was accidental (perhaps reflex).

Yet, in a sense this urea variation is not accidental. Guyon and Albarran long ago showed that the gravely diseased surgical kidney has a practically constant output of urea and of water during the 24 hours, while the output of solids and fluid from the normal kidney constantly varies. It shows its functional capacity (its reserve force, as Barringer aptly terms it) by constantly varying its output in accord with the constantly varying physiologic requirements, while the gravely diseased kidney is working under pressure and at top speed, as it were, all the time. This observation gave the suggestion from which Albarran subsequently developed the experimental polyuria test.

But in my experience it has been almost impossible to gauge the amount of water necessary to ensure polyuria. I have employed only tap water, seconded in some instances by whiskey. I find that:

1. Many patients refuse to drink more than three glasses of water in fifteen minutes.

2. Though this amount is quite sufficient in some instances, notably in neurotic subjects, to excite intense polyuria,

3. In others, even the addition of whiskey may fail to produce polyuria within an hour.

4. Therefore, it is my custom to encourage the patient to drink at least four glasses of water, and a drink of whiskey.

Thus, at the very outset, in experimenting upon normal cases we are met with a difficulty of which Albarran's classical charts give us no warning, and at first sight this difficulty seems grave enough to shatter the whole fabric. Indeed, the investigators who have endeavored to verify Albarran's results have all felt the force of this objection and have very generally made it their excuse for rejecting the test.

But in spite of the fact that the "experimental polyuria" test may not succeed in exciting polyuria, it has distinct value. For even without experimental polyuria, the output of the normal kidney varies from one-half hour to another (Chart III), and may thereby be distinguished from its diseased fellow, which shows a slighter variation. A successful experimental polyuria simply enhances this natural discrepancy. If the discrepancy is naturally great, no enhancement may be required; but if the discrepancy is slight, every effort should be made to induce the patient to take at least four glasses of water and a drink of whiskey during the second half-hour of the examination. Moreover, it is in just these doubtful cases that the four full half-hours,* which may otherwise be cut down to three, are required.

Yet, since there always remains a doubt in one's mind whether the experimental polyuria is actually at work, we require some criterion of this fact. Such a criterion we possess in marked and progressive urinary dilution. When, as in Case IV and Charts I and III, the percentage of urea falls markedly during the third half-hour, one recognizes that the experiment is working, while if, as in Cases I, II, III, and V and Chart II, the percentage of urea varies but little or actually rises, one must consider the polyuria at least relatively ineffectual and study the results as representing a series of ureter catheter-observations.

General pathological conditions may gravely upset an experimental polyuria test. One case, catheterized while the temperature stood at 102–4° F., showed, when charted, a totally eccentric curve (Case II). But the constantly high percentage of urea attested the integrity of the two kidneys, and whether the test failed by faulty technic or as a result of toxæmia makes no difference in the conclusions drawn.

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* In some hypersensitive patients it has seemed wise to shorten the periods to 20 minutes each.

Similar conditions are illustrated in two other cases both with gravely tubercular kidneys and bladders so diseased as to prohibit cystoscopy; † both had nocturnal polyuria. Radiography apparently demonstrated a gravely diseased kidney in each instance. In order to make some test of the functional capacity of the healthy kidney, phloridzin was injected (and its appearance delayed more than an hour in each instance) and experimental polyuria of the combined urines performed both in the morning and at midday.

The good curves obtained from the midday experiment were justified in one case by successful nephrectomy; in the other by the discovery of a kidney only slightly hydronephrotic (the radiograph having been misleading). Yet in each instance the pathologic nocturnal polyuria overshadowed the experimental polyuria, flattening the curve.

From these observations, I would submit the following conclusions in reference to the normal kidney:

1. Experimental polyuria usually increases the quantity and dilutes the urea in the urine of the normal kidney; the work actually done usually increases.

2. In some instances, however, the quantity does not increase, while the urea percentage does.

3. In the presence of certain marked pathologic influences (grave toxæmia, nocturnal polyuria) the effect of the general condition upon the normal kidneys may be such as to more than counterbalance the natural effect of the experimental polyuria.

4. It is quite probable that even a considerable pathologic stimulation might be overcome by an excessive experimental stimulation and therefore, whenever possible, the patient

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† One was so sensitive he would not permit cystoscopy under any conditions; the other had a tubercular bladder and a large tubercular abscess in the prostate.

should drink more than three glasses of water, or should add whiskey to the water.

5. The efficiency of the polyuria may be estimated by the fall in urea percentage, especially during the third half-hour.

6. If the test fails to excite polyuria, it is, nevertheless, valuable as affording several observations on the comparative functional activity of the kidney.

7. Variations in quantity and quality in the absence of polyuria are suggestive of good functional activity.

The Diseased Kidney.—When one kidney is normal and the other markedly diseased, experimental polyuria gives very striking results, as exemplified in Chart III, taken from a case of Dr. Watson's, from whom almost the whole of one kidney had been removed, the remaining fragment being gravely infected and probably insignificant in size.

The normal kidney presents the familiar curve, while the diseased one presents three striking differences:

1. The quantity and quality of urine excreted by the diseased kidney are markedly inferior to those of the urine excreted by the healthy kidney.

2. The curve of the diseased kidney is less abrupt than that of the normal kidney; it may even fall instead of rising, and the impairment in kidney function is generally proportionate to the flatness of the curve.

3. The disparity between the curve of the healthy and the diseased kidney is proportionate to the amount of artificial stimulation. Compare the curve in Chart I, excited by two glasses of water and a half ounce of whiskey, with the absence of polyuria shown on Chart II, after four glasses of water, while the most striking polyuria of all, shown in Chart III, is where the patient drank seven glasses of water.

Both Kidneys Gravely Infected.—Chart IV is from a patient whose life was saved six months before by a Chetwood operation done under local anæsthesia. He had complete prostatic retention for ten years, and a prostatic abscess at the time of operation; his condition was so grave that general anæsthesia was deemed impracticable. Recovery from operation was complete. The retention had been relieved, but the suppuration in his kidneys of course continued. This chart shows a right kidney doing very little work, as shown by the urea in centigrams, and by the relative straightness of its line of excretion as compared with the left kidney; but even the left kidney is gravely impaired, as suggested by the fact that it responds but lightly to the polyuria. Phloridzin glycosuria in this case was delayed for six hours, and the argyrol injection test showed marked dilatation of the pelves.

Slight Renal Impairment.—When one or both kidneys are but slightly damaged by retention or suppuration, or when the difference between the condition of the two kidneys is not great, the experimental polyuria test, like every other test of renal function, is put to its severest trial to distinguish the precise conditions present.

Chart V illustrates such a condition. In this case, there were aseptic oxalate calculi in the left renal pelvis which I subsequently removed successfully. This chart shows a marked polyuria of the diseased side throughout the test, and only a slight average deficiency. Operation revealed a kidney normal to all appearances, and a pelvis only slightly thickened. Stones were removed by pyelotomy. It is my impression that if this patient had drunk more than three glasses of water, or added a glass of wine or whiskey, the polyuria induced in the normal kidney might have overcome the pathological polyuria due to stone. This chart gives no precise indication of any abnormality in the kidneys; it is not nearly so abnormal as Chart III, for instance, yet, had the experimental polyuria not been performed, the considerable difference in quantity and urea volume might very well have led to the belief that the right kidney was more diseased than the calculous left one.

Chart VI is of peculiar practical interest. It shows deficient polyuria in the left kidney. This patient was brought to me as a case of nephritis. Investigation revealed urethral stricture, which for twenty-five years had been insufficiently dilated, and the urine contained pus, bacteria, a little albumin, and a few casts. The patient was X-rayed several times, and every plate showed shadows of a supposed stone in the left ureter. A functional test was then made, showing deficiency of the left kidney. The inference so far was absolutely confirmatory of stone in the left ureter. The pelves of the kidneys were then injected with argyrol, and the patient again X-rayed,* showing that the suspected stone was outside the urinary tract, but that the left ureter was probably slightly adherent to the lower pole of the kidney. I have no doubt that the deficiency of the left kidney in this case was due to renal retention from adhesions about the pelvis.

When one kidney is gravely diseased and the other practically normal, experimental polyuria may not be necessary to indicate the site of lesion, and this is especially true if the microscope shows abnormal constituents in the urine from one kidney and not from the other. On the other hand, if one kidney is but mildly diseased and the function about equally impaired on the two sides, experimental polyuria, as I have performed it, may not clearly indicate which side is the more diseased. I think, however, that in future the use of more water or of alcohol in addition to the water, will give me better results in this regard. Yet experimental polyuria is no more infallible than any other test of renal function. Its chief virtue is that it multiplies the observations of urine drawn from the two kidneys under varying conditions. We actually put the kidney through its paces and thereby get a much more definite idea, in the main, of what it can do than we could possibly get by any single observation. In doubtful cases, the artificial excretion tests are of value. Estimations of the urea percentage and urea in centigrams are, of course, eminently essential to the study of the precise function of the kidney: but the series of observations possible with experimental polyuria gives us a point of view that we cannot otherwise obtain.

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* See Trans. Urological Association, 1909.

Difficulties.—The test is a prolonged strain on the patient's patience, and upon his physician's as well. Moreover, close personal attention is required to prevent errors. A small catheter with several eyes (I employ a No. 8 ureter catheter) must be left in the bladder throughout the test and 1 c.c. of boric acid solution injected through this at the end of each period to ensure its patency and prove whether any urine has flowed past the ureter catheters (extra-catheter flow) into the bladder. Moreover, the catheters must be flute tipped, size 6 or 7, and introduced at least 15 cm. up the ureters. The flow from them must be constantly watched. If it stops for an unduly long time 1 c.c. of boric acid solution is injected into the catheter (and this injection allowed for in computations) to dislodge any clot of pus or blood that may be blocking it.

Functional Diagnosis of Renal Diseases.—The following cases may serve to illustrate how misleading features in the urinalysis of specimens obtained during the first period are controlled by comparison of the urinalyses obtained at subsequent periods.

Case I.—Male, 51 years of age, with slight prostatic retention, residual urine varying from 20 to 80 c.c., and vague, persistent pains in the left side. Experimental polyuria; three glasses of water administered at the end of the first half hour; no pus, bacteria or casts from either kidney.

	R.			L.		
	c.c.	Urea %	Urea in cgm.	c c.	Urea %	Urea in cgm.
1st half hour	25.5	1.3	33.15	15	1.15	17.25
2d half hour	33.	1.1	36.3	37.5	1.1	41.25
3d half hour	65.	2.25	146.25	55.	2.35	129.25

Conclusion: kidneys normal.

Case II.—Male, aged 35; septic; no focus ascertainable; obscure abdominal pains. Experimental polyuria; three glasses of water administered after first half hour; both ureters catheterized; no pus, bacteria or casts from either kidney.

	R.			L.		
	c.c.	Urea %	Urea in cgm.	c.c.	Urea %	Urea in cgm.
1st half hour	13.	3.5	45.5	Only a few drops.		
2d half hour	2.5	3	7.5	5	2.8	14
3d half hour	1.5	2.8	4.2	18	3	54

Conclusion: kidneys normal. Catheters probably plugged by blood clot.

Case III.—Female, aged 27; left renal colic; radiograph shows two stones in left renal pelvis. Experimental polyuria; three glasses of water administered after first half hour; no pus, bacteria or casts in either side; periods of twenty minutes.

	R.			L.		
	c.c.	Urea %	Urea in cgm.	c.c.	Urea %	Urea in cgm.
1st period	21.	0.5	4.2	48.	0.425	20.4
2d period	18.5	0.0	16.65	53.	0.16	8.83
3d period	74.	0.1	7.4	129.	0.04	5.16

Conclusion: left kidney congested.

Case IV.—Male, aged 26 (Dr. Watson's case, Chart III). After injection of 1 c.c. of 1 per cent. phloridzin, sugar appears in fourteen minutes from the right kidney, in seventeen minutes from the left. Experimental polyuria, periods of an hour. Drank seven glasses of water after the *second* half hour. Fourth period calculated from specimen collected in 12 minutes; pus and bacteria from both sides; renal epithelia profuse from left side, very few from right.

	R.			L.		
	c.c.	Urea %	Urea in cgm.	c.c.	Urea %	Urea in cgm.
1st period	44.	2.1	59.4	45.	0.4	1.8
2d period	88.	1.2	105.6	11.5	0.2	2.3
3d period	281.	0.15	394.5	23.	0.1	2.3
4th period	595.	0.075	446.25	55.	0.08	4.4

In this case Dr. Watson was in doubt whether the congenitally misplaced and pyonephrotic left kidney had or had not been completely removed. The urine from the left kidney (as it proved) discharged from an abdominal sinus, the connection of which with the bladder had been suspected. The polyuric test proved the presence of a fragment of the left kidney.

Case V.—Female, aged 29; repeated right renal colics; intermittent tumor in right loin; right kidney movable; subsequent operation showed right infected hydronephrosis due to adhesions of the pelvis to the lower pole of the kidney. Experimental polyuria, with three glasses of water at the end of the first half hour; pus from right side only. Argyrol injection and radiography showed a dilated right kidney pelvis.

	R.			L.		
	c.c.	Urea %	Urea in cgm.	c.c.	Urea %	Urea in cgm.
1st period	2	1.5	3	6	1	6.
2d period	0.5	0.5	0.25	7	1.5	10.5
3d period	2.5	0.4	1	11	1.25	13.75

Conclusion: dilation of infected right kidney.

INFECTIONS OF THE URINARY TRACT DUE TO BACILLUS COLI AND ALLIED ORGANISMS.

FURTHER OBSERVATIONS ON THE TREATMENT OF ACUTE AND CHRONIC CONDITIONS.

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AND

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In an Erasmus Wilson Lecture for 1908, delivered by one of us (L. S. D.) before the Royal College of Surgeons of England, attention was drawn to certain infections of the urinary tract caused by the bacillus coli. Owing to the wide experience we have had during the past two years in the treatment of such infections under all possible conditions, both in hospital and private practice, we have thought it advisable to record our further observations.

The main points presented by this class of case were fully dealt with in the original lecture, and in the present communication we shall very briefly recapitulate them, only dwelling at length on the newer matter with which extended knowledge has furnished us.

Clinically the cases of bacillus coli infection naturally group themselves into chronic and acute. The acute cases are particularly liable to be mistaken for an acute infection of any kind when first seen, according to the direction in which the various signs and symptoms may seem to point. In all cases an examination of the urine in the bacteriological laboratory is necessary to confirm a diagnosis of colon bacilluria, however probable such a diagnosis may appear from the clinical aspects alone. In these acute cases there is pyrexia between 101° and 103° F., and a rigor may be the first indication that the patient is ill; there is usually frequency of micturition and pain. The urine is acid and turbid from the presence of bacilli.

With regard to chronic cases further experience has fully borne out the opinion previously expressed, that "It is impossible to give an account of the clinical features of these chronic cases, because the symptoms may vary from a few apparently unimportant facts to a condition of considerable severity, while in many instances there is nothing to suggest from the patient's symptoms that there is anything abnormal in the urine." It is now known that most of the cases of "catheter fever" which have been examined bacteriologically are the subjects of an infection of the urinary tract. The bacterium concerned has either been the bacillus coli, the bacillus proteus, or some other allied organism. Treatment with a vaccine prepared from the infecting organism in some instances permitted the subsequent passing of catheters or sounds without any untoward symptoms, and in other cases acted as a preventative of rigors.

The Urine.—Most commonly the reaction of the urine is acid,* but on the other hand it is more often alkaline than might be supposed. The following types may be noted.

A. Urine quite clear, but on cultivation the bacillus coli is detected.

B. Turbidity of varying degrees. Bacilluria.

C. Similar to type B, but with varying degrees of inflammation as shown by a deposit of leucocytes.

D. Pyuria and bacilluria.

E. Pyuria, and on cultivation the bacillus coli is present.

Microscopical Examination.—An inspection of centrifugalized film preparations from cases of bacilluria reveals the presence of bacilli in varying numbers and polymorphonuclear cells. Attention has already been directed to the fact that, "in every case of bacilluria a centrifugalized specimen of the urine will show one or two polymorphonuclear leucocytes in a film preparation"; in every instance the bacilli are mainly extracellular. Here and there bacilli may be noted inside a polymorphonuclear cell, but not more than about 10 per cent.

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* This refers to infection due to a bacillus coli.

of the cells in the urine are phagocytic, and in these there are as a rule not more than 10 to 15 bacilli. In typhoid infections, on the other hand, the bacilli are present in the cells, and the latter show a high degree of phagocytosis. No advantage is gained by estimating the number of bacilli present to the cubic centimetre in a sample of urine, for this number varies from day to day. Naked-eye examination of the specimen together with an inspection of film preparations is sufficient to judge of the effect of treatment.

Bacteriology of the Urine.—The importance of a thorough bacteriological investigation of the urine is a *sine qua non* both from the standpoint of diagnosis and also of treatment. In all instances the specimens for examination must be collected in sterile test tubes, and in dealing with female patients the use of the catheter is also necessary.

Atypical colon bacilli have in some examples been demonstrated and cultivated in the urine; such bacilli lack certain features which are necessary for their inclusion in the true colon group. Several examples have now been met with in which differential tests have resulted in placing the infective microörganism in the paracolon and paratyphoid group. Moreover, we may further cite one or two examples treated in private where it was found that, on making a re-examination of the urine during the course of treatment, the organism has shown different cultural characteristics in that it failed to give one or more of the sugar tests which it had done previously; it is more likely that we were dealing with the same organism in spite of these facts, than that a different strain of bacillus coli had made its appearance in the urine during treatment.

Examination of the Urine in Pregnant Women and During the Puerperium.—We prefer the term "pyuria" of pregnancy to "pyelitis," "pyelonephritis," etc., on the ground that these terms make a definite assumption as to the exact anatomical site of the lesion in the urinary tract—an assumption which often lacks proof.

Extended observation has afforded many instances of the pyuria of pregnancy in which there has been an acute infection of the urinary tract by the group of microörganisms now under consideration. Several of these cases have now been treated by a vaccine and some with sera; the results have on the whole been satisfactory, for the temperature became normal, the constitutional symptoms disappeared and a complete recovery from the pyuria ensued; more often, however, while a recovery, satisfactory in every way to the clinician occurs the state of the urine still remains abnormal—viz., the bacilli are present and pus may or may not continue to be present.

Many important points concerning the immunopathology of these cases have been dealt with at great length in the lecture already referred to, and little more need here be said on this aspect of our subject.

It may be noted with regard to the occurrence of opsonins in normal and pathological urine that, as the outcome of experiments *in vitro* with the bacillus coli, there is no evidence to show that substances exist in these urines which increase or inhibit phagocytosis except in a few instances. It is unusual for phagocytosis to occur to any extent in the urine of patients suffering from either acute or chronic infection of the urinary tract due to the bacillus coli.

It was also found that when the agglutinative properties of the patient's serum were tested on his own bacillus, or on a stock laboratory strain of bacillus coli, the reaction was of no value for making a diagnosis of this affection in the majority of cases. In most instances patients suffering from an infection of the urinary tract due to the bacillus coli, whether it is acute or chronic, show a low opsonic and phagocytic index. In chronic cases the index was low in almost every example examined. Treatment by vaccines causes a gradual rise in the index as is also the case when anti-coli serum is employed; but sometimes the index remains low in spite of treatment. The following quotation embodies the general conclusions which were drawn from these investigations. "The experiments which have been done on the subject hardly justify us in placing too much reliance on the opsonic and phagocytic index for the diagnosis of bacillus coli infections. The very wide variations obtained in the opsonic content of the blood of healthy men, and still more so in human blood derived from all kinds of acute and chronic diseases, infectious and otherwise, are sufficient to show that it is difficult to say what is normal or abnormal." Normal human serum was found not to exert any bacteriacidal action on the bacillus coli.

PROGNOSIS.

In the most successful examples all the symptoms and physical signs disappear and it can be proved culturally that bacilli are absent from the urine, which is now clear and limpid in place of being turbid from the presence of bacilli and leucocytes. In those instances in which the bacilluria persists, the number of organisms may be greatly reduced and the urine becomes clearer. It must be remembered, however, that the condition of the urine can be shown by frequent microscopical and bacteriological examination, to fluctuate from day to day. In most instances when treatment is concluded such symptoms as pain or frequency of micturition have subsided, and if fever has been present at any time, the chart now shows absence of any marked pyrexial disturbance, and, moreover, these statements apply to those cases in which the bacilluria may not have been cured.

This clinical cure is a most striking feature of those cases in which the bacilli still persist in small numbers in the urine. An instance may be cited where on the last test re-examination of the urine in a case of colon bacilluria some bacilli were still found to be present, but these were proved not to be bacillus coli. We may take it that in the majority of cases of bacillus coli bacilluria, a "complete cure," *i.e.*, absence of bacillus coli in the urine, is not effected.

What has previously been said as to the necessity for eliminating complications before treatment for pyuria is undertaken need not be repeated; but again we must insist on the vital importance of a preliminary surgical examination in elderly patients to exclude such conditions as malignant growth in the bladder. In such a case there was said to be no evidence of this nature on clinical examination, and the patient's urine was found to contain pus and bacilli of the colon and paratyphoid families. Later on, a large quantity of blood and pieces of striped muscle tissue were detected in the urine. At a second physical examination of this patient an intestinal growth was found which had ulcerated through the bladder wall and had previously escaped recognition. It is well to bear in mind that the presence of blood in the urine is strikingly uncommon in bacillus coli infections, and when it occurs, strongly suggests that the part played by these organisms is of secondary importance.

TREATMENT.

In acute cases excellent results have been obtained by giving the anti-bacillus coli serum. This serum is given in doses of 25 c.c., spread over 72 hours, and it is essential for the patient to remain in bed for about a week during this course of treatment. It is desirable that great care be taken to ascertain that the patient has not received serum treatment for this or some other affection at a more or less recent date. In acute cases during pregnancy and in old people it is safer to give vaccine, as occasionally severe constitutional symptoms follow serum treatment. In all cases, when it has once been established on a sure bacteriological basis that the infection is due to the bacillus coli or an allied organism, it is especially recommended that the patients be treated during an acute attack or an acute phase of a chronic attack, since it is then that the best results are obtained. For chronic and subacute cases if any treatment is undertaken it should undoubtedly be by means of vaccines, as treatment by drugs is entirely without effect in colon bacilluria, a marked contrast to the success which attends the exhibition of urotropin and kindred drugs in typhoid infection. In the later stages of acute cases distinct benefit has been noted when the anti-coli serum was supplemented by a vaccine. The importance of preparing the vaccine from the patient's own microörganism cannot be overestimated, as to obtain the best results this must be done in every instance.

The vaccines are killed by heat, and it is rare to find two strains of the bacillus coli killed by exactly the same temperature. Unlike many of the coccal and typhoid vaccines, it is uncommon for constitutional symptoms of any degree to follow the injection of bacillus coli vaccines. It is better to give vaccines by intramuscular than by subcutaneous injection, and also the site of inoculation should be varied and the injections made into different areas in rotation. Altogether some 100 additional examples of this affection have now been treated since the first communication on this subject was made by us. In a majority of the acute cases, which form a small proportion of the whole, complete recovery ensued; but in the case of those suffering from the chronic type of the disease complete recovery, *i.e.*, a sterile urine on more than one examination, must be classed as exceptional. In a large number of instances of pyuria and bacilluria associated with symptoms of various kinds, considerable improvement was effected, in some the condition remained much as before; while of those examples of pure bacilluria without symptoms a few were treated, but the results as far as the condition of the urine was concerned must be regarded as unsuccessful.

With regard to dose, we have tried both the large dose every 10 days and the smaller one every 5 days, and we are of opinion that small doses of between 100,000,000 and 200,000,000 bacilli administered every 5 days give the best results.

In conclusion it must be noted that relapses are liable to occur after successful treatment of these cases of colon bacilluria.

INTRAPERITONEAL DIVISION OF ONE URETER.

A CLINICAL AND EXPERIMENTAL STUDY.*

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The object of this work has been to determine primarily the effects of the leakage of normal, sterile urine into the peritoneal cavity. It has been done before by several others, especially by Israel and Grawitz, in 1879; by Tuffier and by Strauss, in 1890; by Willgerodt, in 1897; and by De Quervain, in 1901. Their observations are not wholly in accord and in some respects are incomplete. The subject has also been studied by writers on intraperitoneal rupture of the bladder, but their conclusions are not of real value in this connection because bladder urine is so seldom sterile.

All writers agree that septic urine will cause peritonitis. Others claim that urine presumably sterile, is harmless to the peritoneum if allowed to come in contact with it for only short periods of time. Dambrin and Papin, Tuffier, Vincent, Strauss, Delbet, and others have shown this to be true experimentally. Clinically it is often seen.

Still others, among them Pozzi, Schede, Petroff, Albarran, König, and Küster maintain that septic peritonitis inevitably follows any extravasation of urine, or of blood and urine, into the peritoneal cavity, while Grawitz, in 1888, claimed that peritonitis was due not to urine but to blood.

The simplest and best way to produce such a urinary extravasation is to cut one ureter, allowing its urine to flood the peritoneum. This has the advantage of allowing sufficient urine to be excreted by the sound kidney, and furnishes urine as sterile as any that can be obtained. This was done on 40 animals, of which there were 25 rabbits, 1 guinea-pig, 11 dogs, and 3 cats. Thus there were 26 herbivora, and 14 carnivora.*

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* Read in abstract before the American Urological Association, June, 1909.

The operation was as follows. Animal etherized. Abdomen opened with all possible asepsis, by a median incision. Left (sometimes the right) ureter isolated by tearing through the peritoneum, freed from its surrounding fat and cellular tissue, ligated with No. 0 chromic catgut at about the pelvic brim, and divided on the proximal side of the ligature. After noting that the divided ureter functionated normally, it was left lying in its proper position on the psoas muscle. The abdominal wound was closed tight in layers with No. 0 chromic catgut and silkworm gut. A sterile gauze cocoon was sometimes applied, but more often not, as the results were found to be as good without it.

The effects of this operation were as follows. Primary union of the laparotomy wound occurred in only 50 per cent. of the herbivora, never in the carnivora. Strauss reported the same difficulty.

† Rabbit 488.—July 17: Laparotomy by median incision three inches long. No free fluid. Left ureter isolated, ligated with No. 0 chromic catgut, and divided proximal to ligature. Urine ejected normally. Wound closed in layers with No. 0 chromic catgut and silkworm gut. July 20: Animal apparently perfectly well in every way since operation. Killed with strychnia. Upper two-thirds of wound perfectly clean and apparently healing by first intention. Lower third infected and bathed in thick pus.

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* The writer wishes here to express his gratitude to Dr. Theobald Smith for most valuable advice and suggestions; to Dr. Harold C. Ernst, for the privileges of the Bacteriological Laboratory and for many helpful hints; and to Mr. Fred L. Green, of the Laboratory of Surgical Research, for prompt and efficient execution of many details of the experimental work.

† This and subsequent animal protocols are inserted in order to illustrate the point in question. They are mostly brief summaries of the record, and in each case have been selected as representative of the group.

Dog 39.—February 10: Operation and technic same as in Rabbit 488. February 11: Very sick. February 12: Killed with strychnia. Autopsy: Wound shows few drops of thick green pus at upper and lower extremity.

Dogs and cats become at once desperately ill, and always die of sepsis in from four to eleven days, occasionally showing uræmic symptoms such as diarrhœa and vomiting.

Cat 5.—June 4: Operation and technic same as before. June 4, afternoon: Very sick. June 5: Somewhat brighter, but still very wretched. Has vomited two or three times. Very thirsty, but does not eat at all.

Dog 4.—October 22: Operation and technic as before. Four hours later: Good recovery; seems fairly happy. October 23: Very sick. Much emaciated, nose dry and hot; very thirsty and drinks water constantly. October 24: More active than yesterday but still very miserable. Stomach contents regurgitated frequently. Drinks much water.

Rabbits are little if at all affected and always recover. Israel and Grawitz were fortunate enough to keep their dogs alive from four to five weeks under similar conditions. The temperature proved so variable and unreliable that attempts to record it were abandond early. An autopsy was done in every case. Adhesions between omentum or gut and the wound were nearly always present. Free fluid, containing urea, was found in the abdomen in about 50 per cent. of cases. It was greater in amount in animals killed within the first 48 hours, than in those killed at a later time.

Rabbit 466.—July 21: Usual operation. July 22: Apparently normal but does not care to move much. Killed with strychnia. Autopsy. Wound perfectly clean macroscopically. Peritoneal cavity contains about *two or three ounces* of clear straw-colored fluid, which shows the presence of urea.

Rabbit 495.—July 10: Usual operation. July 17: Nothing abnormal noted about animal's condition during the week. Killed with strychnia. Autopsy: Wound firmly united except at lower end where there is a slight infection. No free fluid in peritoneal cavity.

In this my findings disagree with those of Ferraton, whose observations (in cases of intraperitoneal rupture of the bladder) showed less fluid in the early than in the later cases. He claims that this is because the fluid is absorbed by the peritoneum as fast as it is poured forth, until peritonitis sets in (which it does in the first 24 hours or so), when the absorptive power of the peritoneum is gradually lost and the fluid simply accumulates in an inactive cavity. This coincides with the theory of Wagner that the absorptive power of the peritoneum depends on the peristaltic movements of the intestines and aspirating power of the diaphragm, and that these activities cease with the onset of peritonitis. My own belief is that in spite of the great power of absorption possessed by the peritoneum, it cannot keep pace with the great effusion occurring soon after the peritoneal insult; hence the free fluid seen in early cases. The absence of fluid in the later cases may be explained by the fact that the effusion of urine and serum has stopped and that already poured forth is sooner or later absorbed in spite of the presence of peritonitis.

The fluid was usually clear, yellowish, and of a urinous odor. When tested it always showed the presence of urea. Occasionally it was bloody and turbid, and in carnivora purulent.

Peritonitis was always found, appearing earlier in rabbits than in dogs. In herbivora it is quite noticeably localized to the side of the divided ureter.

Rabbit 487.—February 17: Usual operation. February 19: Apparently unaffected by operation. Killed. Autopsy: Not noticeably emaciated. Wound dry and clean macroscopically. Delicate adhesions between intestines and under surface of wound. Peritonitis fairly well developed, localized quite sharply to operated side where coils of gut are adherent to one another enclosing between them small amounts of clear urinous fluid, and large masses of clotted lymph. Coils of gut adherent to cut end of ureter forming a little cyst-like cavity with a little fluid in it. Tremendous œdema of all surrounding tissues.

In carnivora, peritonitis may be localized but it is more often general. It was characterized, especially in rabbits, by marked and extensive œdema, and very marked engorgement of the blood vessels running over the injured ureter and its kidney.

The exudate in dogs and cats was always purulent; that of rabbits always fibrinous, consisting of large masses of clotted lymph.

In 77 per cent. of cases, best seen in rabbits, distinct walling off of the divided ureter was accomplished by adhesions between gut, omentum, abdominal wall and ureter, in one or more combinations, forming a unilocular or multilocular cyst.

Rabbit 495.—July 10. Usual operation. July 17: Nothing abnormal noted about animal's condition during the week. Killed with strychnia. Autopsy: On left side of abdomen two rounded tumors, one above the other, each the size of an English walnut. On palpation these are round, smooth, soft, elastic, and easily movable. Peritoneum smooth and shining throughout, intestines not injected. On removing coils of gut from left side left kidney is found to be about twice normal size, soft and cystic. Just below this there is a mass of small intestine matted together and forming a tumor the size of an English walnut. Stringy, gelatinous masses of fibrin here and there in this region between coils of gut, some free and some adherent. Kidney-pelvis and ureter much dilated (latter size of slate pencil), the latter leading into the mass of adherent gut below. This mass is cystic and on squeezing first it, and then the ureter, fluid is easily seen to be transmitted from one to the other. This cyst opened with the escape of about two ounces of clear, amber fluid, which could be seen to gush out from the distended ureter with subsequent collapse of the latter. Cyst cavity lined with thick, œdematous, translucent exudate, presumably fibrin.

Willgerodt, and later De Quervain, also observed this protective cyst formation, and it could not be prevented in spite of every effort on their part. On separating these adhesions the fluid gushed forth as if under great tension.

The proximal end of the ureter was often hard to distinguish, being buried by exudate and œdema. It ceased to functionate usually in 24 hours, but was sometimes seen to eject urine as late as 60 hours after operation. So far as could be determined its divided end became occluded by:

1. Direct adhesions to gut or omentum. This was noted by Israel and Grawitz.

2. Blood clot in its lumen, often extending almost up to the kidney.

3. Organization of exudate; seen only in late cases. Often no special cause could be demonstrated. The distal end of the ureter with its ligature presented nothing remarkable.

Noticeable and often marked dilatation of ureter and kidney pelvis was seen in about 66 per cent. of cases. It occurred oftenest in rabbits. Often, even with considerable dilatation of the ureter, a normal jet of urine was seen, indicating perhaps, partial stenosis. On section of an occluded ureter there spurted forth, as if under great tension, a variable amount of clear, turbid, or bloody urine. The ureteral walls were thin and soft; the kidney was œdematous, soft, and always more or less typical of hydronephrosis.

Rabbit 472.—February 24: Usual operation. February 26: Animal apparently unaffected by operation. Killed. Autopsy: Wound clean and dry. Abdomen contains very little free fluid. Coil of gut lightly adherent to site of divided ureter, which is completely hidden by œdematous tissue. Little clear, encysted fluid. Ureter much dilated. On section fluid gushes forth under considerable pressure. Kidney about three times normal size, not injected. On section markings not to be made out, pelvis and calices very much dilated, the whole a picture of moderately developed hydronephrosis.

No important macroscopic changes were seen in the other abdominal or thoracic organs, except in dogs and cats, which had developed metastatic abscesses.

The microscopic lesions were studied for me by my friend Dr. S. Burt Wolbach, formerly of Harvard, but now pathologist to the Montreal General Hospital. He reports no evidence of any value. The kidneys of the operated side show in most cases more or less parenchymatous degeneration, more commonly in rabbits. There were casts in the tubules and occasional infiltrations of leucocytes and cocci in the pelvis and cortex. This was commonest in dogs, who always showed purulent processes. The sound kidneys were practically negative.

The operated ureters showed dilatation, with thin, but otherwise normal mucosa. Their muscular, fatty and peritoneal coats showed in some cases œdema, necrosis, or infiltrations of leucocytes, round cells, or fibrin. Other organs, such as liver and spleen, were essentially negative.

Practically all of these lesions, except those of the ureter, may be found even in presumably healthy, unoperated laboratory animals, and the findings are therefore inconclusive.

So far as I am aware, the bacteriology of this problem has never been studied before.

Positive cultures were obtained from the peritoneal cavity in all the dogs and cats, and in 50 per cent. of the rabbits. In a certain number of cases the same organism was obtained from the laparotomy wound. Curiously enough the organism in all but one or two cases, was a coccus, corresponding closely to the Staphylococcus pyogenes albus.

In a certain number of cases the culture from the general peritoneal cavity was positive, while that from the encysted fluid was negative; in other cases the findings were reversed.

Rabbit 473.—February 24: Usual operation. February 28: Animal seems pretty well but is somewhat emaciated. Killed. Autopsy: Wound dry and clean. Very little free fluid. Culture shows pure growth of Staphylococcus albus. Coil of gut adherent to cut end of ureter, making a little cyst of clear fluid. Culture from this fluid is negative.

The question now arises whence this infection? If from extraneous sources it is unlikely that a pure culture of the same organism would be present in every case, and also it is a fact that even with the mildest asepsis, animals are remarkably resistant to infection. If autogenous, the organism must come—

1. From the blood stream through the kidney (hematogenous).
2. From the urine itself.
3. By migration through the intestinal walls.

We know from the investigations of Ford, that every so-called healthy animal harbors many varieties of bacteria in its abdominal organs, and that each type of animal has its special bacteriology. Accepting these statements as true, I simply ligated one ureter in several rabbits, but obtained only sterile cultures from within the ureter even after the lapse of some days. To make infection more likely, I ligated one ureter in another series of animals and thoroughly bruised the ureter and its kidney. Again the cultures were negative. The results agree entirely with those obtained by Gayet and Cavaillon in similar experiments. Furthermore, in many cases during the operation of dividing the ureter, I took a culture of the urine as it gushed forth, but every one of these cultures was sterile. This is sufficient, I think, to prove that infection does not come through the urine or through the kidney.

We may also exclude at once the possibility of an infection finding its way up from the bladder through the distal stump of the ureter. This was closed off by a ligature at the time of operation with this idea in mind.

In an attempt to prove that the infection came from the migration of bacteria through the intestinal wall, I examined specially stained sections of gut, taken at a point where they were adherent to the cut end of the ureter, and where there was the most marked inflammation. Diligent search failed to find any bacteria in the intestinal wall. According to Dr. Theobald Smith this is only negative evidence. At his suggestion, I operated on another series of animals. The gut adhering to the cut end of the ureter was then opened, and scrapings from its mucosa were then planted on agar plates. This proved most successful, for in a case where the fluid from the region of the cut ureter showed the usual cocci, the cultures from the gut showed the same coccus in pure culture. It has already been proved by the work of Posner and Lewin that the B. coli at least can easily traverse the healthy wall of the colon. This is perhaps not enough evidence to prove once and for all that this and no other is the source of infection, but it is at least most suggestive. I feel justified therefore in saying that the infection comes from the migration of intestinal bacteria, but why the organism should be a coccus, and not the B. coli, or one of that group, I am unable to say.

Now, why do carnivora invariably become septic and die, while herbivora live whether septic or not?

Firstly, dogs and cats under laboratory conditions, and of a doubtful past, as regards hygiene, are by no means as resistant as the carefully reared rabbit accustomed to cage life. Vincent, in 1881, made this same observation. My experience therefore contradicts the common belief, that dogs are more resistant than rabbits.

Secondly, we must consider the difference in composition of the urine of the two types of animals. The carnivorous urine contains much urea, the herbivorous urine but little. We know also from the work of A. Lumiere, L. Lumiere, and J. Chevrotier, that in laboratory animals, especially dogs, the urine varies considerably from day to day, even under a constant regime. We must therefore believe with them that this will explain the contradictory results of experiments in so-called healthy animals. Other elements probably differ as widely, especially the reaction of the two urines, and according to the researches of Park, the reaction of urine has much to do with its suitability for bacterial growth and exerts an influence on different varieties of bacteria in very different degrees.

The cause of death in carnivora was primarily sepsis, but certainly uræmia played its part. As proof of this I will call attention to the fact that their illness began at once after operation, when urine was being excreted into and absorbed from the peritoneum. Vincent also found that even large dogs could survive a leakage of urine from the bladder for only 48 hours at the longest. I have found this to be true of cats.

Carnivora also do not seem to resist an infection when once started, whereas even when an organism, undoubtedly the same as that found in dogs, was present in the rabbit, the animal seemed to be able to create enough antitoxic power to kill it off. This was well shown in one rabbit, where I did a laparotomy five days after the original operation and obtained a positive culture from the peritoneal cavity. Three weeks later I killed the animal and the culture was negative.

Let us now look at the clinical side of this problem. Traumatic division of the ureter within the peritoneum is one of the rarest of lesions. Accidental division during the course of an abdominal operation is not infrequent, but is either (1) rarely reported, (2) is discovered at once and repaired, so that it does not come within the scope of this paper, or (3) is not discovered (*a*) because the patient goes on to recovery perhaps after a stormy convalescence, of which the cause cannot be demonstrated, (*b*) because the patient dies without demonstrable cause and no autopsy or secondary operation is permitted. Leakage of presumably sterile urine into the peritoneal cavity also occurs in cases of ruptured kidney, but I shall not deal at all with this injury.

In order to obtain clinical material I have made a fairly thorough search of the literature, and have written personal letters to the members of the American Surgical Association, the American Association of Genito-Urinary Surgeons, and the American Gynecological Society, as well as to several others outside of these circles. The responses were prompt and generous, and I take this opportunity to express my gratitude.

Morris was able to collect but three cases of subcutaneous division of the ureter by trauma, which could be proved, and of these only one, the case of Mackenzie, was intraperitoneal. This occurred in an Indian coolie who was jammed between two trucks. The patient died of peritonitis, and at the autopsy there were found two small ruptures, each the size of a pea, in the right ureter, and connecting with the peritoneal cavity. The abdomen contained about two pints of urine and blood. The whole peritoneum was highly inflamed, and the intestines matted togethed with lymph.

Morris also reports two cases of bullet, and three cases of stab wounds of the ureter, of which the most familiar is the case of the Archbishop of Paris. I am aware of the fact that there are a few others scattered through the literature, but I do not pretend to have covered every case in this article.

I have been able to collect from the sources mentioned a total of 29 cases, answering the requirements of my work.* It will be seen, therefore, that such cases are not common. Of these, 20 (Cases I–XX) were proved by autopsy or by secondary operation, and the remainder (Cases XXI–XXIX) must be considered doubtful. The mortality of the proved cases was 25 per cent., that of the doubtful cases 11 per cent. All occurred during the course of a laparotomy, usually for hysterectomy, but sometimes for salpingectomy or appendectomy.

Data of the abdominal findings at autopsy or during the course of a secondary operation were obtained in 17 cases, but are unfortunately scanty. Fluid containing urea was found in 2 cases. In 8 adhesions were present, walling off to a greater or lesser degree the cut end of the ureter, or that part of the abdominal cavity where urine was being poured forth. Peritonitis was mentioned in 9 cases, but was never described as purulent. It was characterized for the most part only by adhesions, injection of the peritoneum, and by fibrinous exudates, as in Mackenzie's case. The kidney and ureter are known to have been normal, macroscopically at least, in 5 cases, while in as many more mention is made of ureteral infection or dilatation, and of pyelitis and hydronephrosis. In nearly all the cases recovering a subsequent nephrectomy with occasional ureterectomy was done. Urinary fistulæ were present in 18 cases. Often it was the first, and in some cases the only, evidence of ureteral injury. These fistulæ occurred mostly in the laparotomy wound, a few in the vaginal vault. Six of these sinuses closed spontaneously in the course of a few weeks or months; 3 were still discharging after the lapse of long periods of time. In 10 cases secondary nephrectomy or ureteral anastomosis was done with prompt closure of the sinus. Taussig quotes Weibel as saying that urinary fistula, from ureteral necrosis, occurred in 24 out of 400 cases, and that practically all of these had healed spontaneously between the third and twelfth week.

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In none of the fatal cases were uræmic symptoms mentioned. This may be explained by the fact that enough urine is excreted through the sound ureter to avert this catastrophe.

It may be said, therefore, that so far as animal experimentation along these lines shows anything, man occupies a place midway between the carnivora and the herbivora in his reaction to an intraperitoneal urinary inundation. Individuals vary greatly as in other lesions, some being highly susceptible and developing a peritonitis at once, others living for many days with the abdomen full of urine. As Vincent truly says, "We must recognize great individual varieties in men and dogs in the susceptibility of the peritoneum."

This great resistance is best illustrated by the case of intraperitoneal rupture of the bladder reported by Quick, where operation with recovery was performed eleven days after the injury and the peritoneum was smooth and shining in the presence of a large amount of urine. Other evidences of the often great resistance to the presence of urine in the abdomen are often reported, but it is to be considered that the urine was *a priori* sterile.

The evidence therefore derived from my experimental work, and from the clinical observations of others, is that the abdomen may bear without damage, and even, in some cases, without severe reaction, the effusion of a certain amount of sterile urine, and that it is able to guard itself quite promptly and efficiently against this effusion by the formation of adhesions. It is also evident, especially in animals, but probably more often than we realize in man, that a divided ureter soon becomes harmless by occluding adhesions or blood clot. It is in those cases where this prompt occlusion does not occur, seen oftenest in dogs, or where the urine is septic from the start, that a general peritonitis sets in.

As I have said before, the first and only sign of injury to the ureter which we may have is the appearance of urine in the laparotomy wound, or in the vaginal vault. In certain other cases accumulating fluid within the abdomen, with or without the formation of a urinary abscess, may be the first sign of the accident. Occasionally a general and severe peritonitis intervenes at once, and the injury is discovered only at autopsy or during the course of a secondary laparotomy.

CASE REPORTS.—I. PROVED CASES.

CASE I.—Woman about 55 years old upon whom a complete hysterectomy was performed for carcinoma, May 23, 1905.

Operation.—The carcinomatous mass involved the cervix and upper inch of vagina. The first step of the operation consisted in freeing the diseased tissue in the vagina. The abdomen was then opened by a median incision. The fundus of the uterus was not enlarged, but the cervix showed a large carcinomatous mass which extended into the broad ligaments on either side. The lymph-nodes along the iliac vessels were involved moderately on both sides. The tubes and broad ligaments were clamped and cut away down to the growth. The uterine arteries could not be secured through the broad ligaments, and the dissection was therefore begun on the outer portion of the mass on the right side. In freeing this mass, the right ureter was found to pass through it and was divided about 1½ inches above its insertion in the bladder. This ureter was later fixed into the bladder. The mass on the left side was freed in a similar manner. The ureter was seen and thought to pass around the growth and not through it. It was believed that the mass was freed from the ureter without injuring it. The uterus and the growth from the cervix and its extension into the broad ligaments were pushed down through the vagina after having been entirely freed. The pelvic floor was then repaired as well as possible from within the abdomen, but owing to the absence of the upper third of the vagina, the repair was not as satisfactory as was desired, and because of the patient's poor condition, the vagina was packed with gauze instead of continuing the repair through the vaginal route.

Two days following operation the packing in the vagina was removed and was found to be soaked with urine. Catheterization of the bladder had on each occasion resulted in the withdrawal of a small amount of urine. The urine continued to come through the vagina until the patient's death four days after operation.

Post-mortem examination showed that the left ureter had been severed in its pelvic portion. The right ureter, which was anastomosed with the bladder was tight. There was considerable fluid in the abdomen which had the characteristics of urine. There was no purulent peritonitis. There was a moderate injection of some of the loops of intestine near the pelvic brim with flakes of fibrin adherent. In the pelvis there were a few coils of intestine slightly adherent to one another and to the field of operation. There was no purulent material found anywhere. The left ureter (the one divided) was not dilated. Neither was there hydronephrosis of the left kidney.

Case II.—Case of exstrophy of the bladder where a Maydl operation was done after several other operations had been tried. After several days, and when the patient was seemingly out of danger, bad symptoms developed and the autopsy showed that leakage had occurred from one of the ureters into the peritoneal cavity. This had resulted from the giving way of the old cicatricial tissue which was very extensive on account of the previous operations. The leakage of urine resulted in general peritonitis and death.

Case III.—Laparotomy for double suppuration of the adnexa uteri. Extensive and difficult dissection. Right ureter torn in act of perforating for drainage hole from the bed of the tumor to the vault of the vagina. During the night following the operation peritonitis set in. It was noticed that urine was escaping from the drainage tube protruding from the vagina. Immediate laparotomy revealed a tear in the right ureter, the pelvic peritoneal space filled with a bloody, turbid, urinous fluid, the intestines all infected and distended. The patient died of peritonitis.

Case IV.—Case in which the ureter had been divided by another surgeon. Apparently not recognized at the time, but as there was vaginal drainage, it drained externally without untoward symptoms. After two unsuccessful attempts by the operating surgeon to unite it to the bladder, the kidney was successfully removed.

Case V.—Operation on an ectopic kidney situated in the right iliac fossa, in which the ureter had been previously cut by another surgeon, thinking that the lesion was an acute appendicitis. This allowed the escape of urine into the peritoneal cavity, apparently doing no special damage, but an obstinate urinary fistula persisted. The kidney was successfully removed several months later.

Case VI.—Supravaginal amputation for myoma of the body of the uterus. A few days after the operation urine began to drain through the lower angle of the abdominal incision. Sinus became infected, patient ran a temperature, and eventually died of septicemia. No further operative interference was permitted.

Case VII.—A young woman with a very large cyst of the broad ligament, which was removed with great difficulty. It was then found that the very tortuous ureter ran for a considerable distance in the wall of the cyst and had been removed with it. The upper end of the ureter coming from the kidney was brought to the upper angle of the abdominal wound and there secured. The patient made a perfectly good recovery from this operation. The kidney was removed some months later on account of the persistent urinary fistula.

Case VIII.—A large intraligamentous uterine fibroid. Left ureter divided in the course of the enucleation of the tumor, but was discovered before closing the abdomen. A portion of the ureter was incorporated in the tumor, thus rendering the immediate anastomosis impossible. It was also impossible to attempt transplantation of the ureter into the rectum or bladder. A drainage tube was therefore placed close to the proximal end of the divided ureter and a fistula established. There was no serious interruption of convalescence in consequence beyond the annoyance and discomfort of the discharge of urine through the abdominal incision. Healing of the incision with the exception of the drainage tract proceeded normally. The patient recovered and went to her home in an adjoining state. The fistula of course persisted, but otherwise she made a perfect recovery.

Case IX.—Young mulatto woman operated on for tubo-ovarian inflammation. During the progress of the operation the left ureter was torn. Two unsuccessful attempts were made in the course of the next three months to repair the injured ureter. Another surgeon was then called in. He opened the abdomen, found that the distal part of the ureter was destroyed in the previous operations and the injury was close to the kidney. A nephrectomy was done with prompt recovery of the patient.

Case X.—Injury to ureter during a gynæcological operation, unrecognized until the occurrence of urinary discharge through the abdominal incision. Unsuccessful attempt to unite the divided ureter, with subsequent reappearance of urine in the wound. Nephrectomy several weeks following the original accident. No macroscopical change present in the kidney and the abdominal fistula healed promptly after its removal.

Case XI.—Panhysterectomy. Peritonitis, more or less general, but having its greatest intensity in left lower abdomen, developed and patient nearly died. Seen in consultation. Septic, and a large mass made out, reaching from a little to the right of the median line well to the left, and four or five centimetres above the left anterior superior iliac spine. Mass incised parallel to and just above Poupart's ligament. Found to be intraperitoneal, containing urine and pus mixed; an intraperitoneal urinary abscess. Large drain introduced and nothing further done at that time, although it was recognized that the left ureter must have been divided. Patient not seen for several months, when it was found that there was a urinary fistula where the drainage tube had been. Laparotomy through left rectus muscle to try to liberate ureter and implant it into bladder. Ureter could not be identified because of mass of adhesions which formed abscess wall. Right ureter exposed and found to be normal. Incision closed and left kidney removed through a lumbar incision. Kidney apparently perfectly normal. Prompt and complete recovery.

Case XII.—Operation for acute appendicitis in a young man. Appendix in pelvic position surrounded by dense old adhesions and adherent small intestines. Organ brought up out of pelvis, between adherent loops of small intestine with gush of straw-colored fluid (about two ounces in amount), and the same fluid welled up during operation. This fluid contained urea. Source of urine could not be determined. Urine from bladder not bloody, and fluid injected came back in same amount. Examination of bladder through median abdominal incision showed no wound. Impossible to examine right ureter because of the densely adherent intestines. Median incision closed with drainage to behind bladder. Appendix incision closed with drainage at upper and lower angles. Stormy convalescence with escape of urine through wound; bladder urine clear. At end of 48 hours urine discharge began to diminish and on the fifth day stopped entirely.

This case was reported by Dr. C. A. Powers, of Denver. He says: "It seems probable that the urinary wound was of the ureter. It is quite possible that the appendix was adherent to it, and that opposite a gangrenous patch in the appendix contiguous ulceration of the ureter had taken place. The ureter was not entirely torn across or such prompt cessation of the urinary flow would not have occurred."

Case XIII.—Ureter cut during removal of fibroid and recognized at the time. End of ureter brought out at upper angle of the abdominal wound but sloughed, allowing urine to escape into the peritoneal cavity. The patient subsequently had pyelitis and the corresponding kidney was removed within two weeks after the original operation. Complete recovery.

Case XIV.—Hysterectomy with ligation and division of ureter. One week later leakage of urine from vagina, with elevation of temperature and signs of irritation within the peritoneal cavity. Abdomen opened, when it was found that left ureter, which had been ligated, was leaking, and was surounded at its end by a small mass of exudate without, however, any marked irritation of the general peritoneum. Ureterovesical implantation, with recovery.

Case XV.—Hysterectomy. Patient developed peritonitis with extensive inflammation which necessitated the reopening of the abdomen, when it was found that the left ureter had been injured, was attached to the side of the sigmoid and there was pyelitis. The left kidney and entire length of the ureter were removed. Complete recovery.

CASE XVI.—A case already reported by Vaughan. Gunshot wound of the abdomen in a man thirty years old. After one week symptoms of peritonitis with purulent discharge from the wound. Laparotomy. Numerous adhesions found but no wound of the abdominal viscera. Wound closed with drainage, followed in one week by purulent discharge through drainage hole and also at point of exit of bullet in back, in region of fourth sacral vertebra. Daily through and through irrigations. In the course of a few weeks the patient improved and the discharge became thin and almost as clear as water. It was found to contain a little pus and a trace of urea. Second operation after three or four months for the closure of the urinary fistula. Patient in good health otherwise. Bladder urine was found to be 22 ounces in the 24 hours, while the amount from the fistula was found to be 48 ounces. Abdomen opened. Many and strong adhesions of intestines with one another and with pelvic walls. Right ureter finally exposed, found to be dilated to at least twice its normal size, and traced into a mass of adhesions in the bottom of the pelvis. In attempting to free the ureter it was broken off at the location of the fistula, as was shown by the appearance of the proximal end. At site of fistula ureter was much contracted in calibre, being not more than one-fourth the size of the dilated portion. The result of this contraction was not only dilation of the ureter but also probably damage to the kidney, as shown by the small percentage of urea found in the urine from the fistula. Ureterovesical anastomosis was done with subsequent recovery of the patient.

CASE XVII.—Double salpingectomy. Ten days after operation fluctuating mass found in pelvis. Vaginal drainage revealed about one quart of purulent urine. Drainage established and one week later second laparotomy was done. Ureter found infected and bound by adhesions. Nephrectomy and ureterectomy through the abdominal incision. Complete recovery. This was apparently not a division of the ureter but rather a sloughing due to loss of periureteral circulation. See Case XXVIII.

CASE XVIII.—Left ureter injured in removing a dermoid cyst which reached to the xyphoid. Injury not detected till abdomen was reopened a few weeks later on account of accumulating fluid. Peritoneum had not suffered apparently. Nephrectomy. No note of condition of ureter or kidney. Recovery.

CASE XIX.—Right ureter injured in removing a retroperitoneal dermoid. Uretero-ureterostomy. Gauze drain to seat of injury. Union failed owing perhaps to moderate sepsis from spilling a few drops of cyst contents. Urinary fistula, and continued high temperature. Nephrectomy three or four weeks after primary operation. Adhesions all about the kidney. Recovery.

CASE XX.—Gunshot wound of abdomen in man of 24 years. Laparotomy showed four perforations of the small intestine, which were repaired.

No wound of bladder found, although bloody urine had been drawn from the bladder. Patient did well for one week when signs of peritonitis appeared and the man died.

Autopsy showed general peritonitis although all wounds of the gut were practically healed. Considerable retroperitoneal hemorrhage, and an acute cystitis, although no wound of the bladder could be found. It was found, however, that the bullet had nearly severed the left ureter so that urine from the kidney of this side must necessarily have escaped into the peritoneal cavity. During life, however, there was no indication of escape of urine, though this was carefully watched for, nor post mortem could one detect any urine in the peritoneal cavity or retroperitoneally. The ureter and kidney of the affected side were quite normal. There were adhesions in the neighborhood of the ureteral wound, but these did not completely wall off the ureter, so that urine might have escaped from the ureter and infected the general peritoneal cavity.

II. DOUBTFUL CASES.

Case XXI.—Median laparotomy in a woman, with persistent sinus. From this sinus there escaped about one quart daily of clear fluid. Operation had been done for right-sided pain, which had been chiefly menstrual. Appendix, and right tube and ovary removed. During the operation a cystic structure near the cæcum was seen. This was pricked with a knife, seen to collapse and forgotten. Abdominal wound closed tight. Normal convalescence. On tenth day a mass, thought to be a hematoma, was found in the scar, and was opened with the escape of clear fluid. Seen by a second surgeon, who catheterized the left ureter easily, but could penetrate the right ureter for only two inches. Second laparotomy showed an apparently normal left kidney, and a large flabby, hydronephrotic right, which was removed.

Case XXII.—A man with gunshot wound of right iliocostal space. Considerable urine escaped from this for some weeks, and then closed spontaneously, assisted by gauze packing. The ureter must have been cut low down, but there was at no time any evidence of peritoneal contamination.

Case XXIII.—Ureter cut in the course of a panhysterectomy. Several months later patient appeared with an abscess discharging through a sinus two inches below the anteriorsuperior spine of the ileus. Urine came freely through this sinus as well. No further notes.

Case XXIV.—Myomectomy for fibroid involving cervical canal. Needle injured left ureter, so that after several days it leaked into the tissue under the peritoneum. Stump of cervix dilated and urine drained into vagina. No further operation allowed for some months, when the kidney was removed. Complete recovery.

Case XXV.—Abdominal section for very extensive papilloma, apparently involving all of the pelvic organs. Twelve hours later patient found to be much distressed. Small part of wound opened and drainage tube inserted with escape of considerable amount of urine. Case progressed to a very satisfactory recovery, except for urinary fistula. Nature of the injury in this case unknown, but a part of the ureter was probably excised with the tumor.

CASE XXVI.—Hysterectomy. During convalescence, when wound had nearly healed, a soft, fluctuating tumor appeared at the lower angle of the wound. This ruptured spontaneously after a few days, discharging a considerable amount of clear fluid, which on examination proved to be urine with a small amount of pus in it. This leakage continued for about a week and then dried up. There have been no further symptoms.

CASE XXVII.—Difficult forceps operation in which the ureter was probably torn or injured. Patient soon developed pain and symptoms of peritonitis, and there was an abscess formation, which on opening contained urine. Patient died of pneumonia, but no autopsy could be obtained, although she evidently had peritonitis.

CASE XXVIII.—Taussig says, " Special care must be taken not to denude the ureter of its nutrient coat of blood vessels for fear of subsequent necrosis. In one of my cases such a ureteral necrosis with resulting fistula developed on the ninth day and persisted in spite of treatment, so that I finally advised a nephrectomy for its relief. The fistula, however, closed spontaneously three and a half months after operation." See Case XVII.

CASE XXIX.—Case seen in consultation of a urinary fistula in the right iliac fossa. This resulted from the accidental wounding of the ureter during a laparotomy for salpingitis. This wound closed spontaneously. The local wound was acutely infected.

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PERINEPHRIC ABSCESS.

A CLINICAL CONTRIBUTION BASED ON THIRTY-SIX CASES.*

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It is the purpose of this paper to report a series of thirty-six cases of perinephric abscess previously unreported, to call attention to certain factors in the etiology and diagnosis of this condition, and to emphasize the importance of clinically differentiating between two types of suppuration about the kidney,—that arising secondary to demonstrable renal infection and that having its origin elsewhere, or at least giving rise to no urinary phenomena.

As is well known the subject has received contributions from many writers and several collections have been made for the purpose of studying these abscesses from various standpoints. Compared to some of these, notably the two hundred and thirty cases of Küster, my series is a meagre one but it has the value of including a fair proportion of observations in the urine, blood and pus which may be of interest. However, before taking up practical considerations I want to call your attention to some anatomical factors which seem to have clinical significance and particularly to refer to certain conclusions which may be drawn from the observations of Zuckerkandl and Gerota on the renal fascia and of Stahr and Cunéo on the lymphatic distribution.

The parenchyma of the kidney is completely and closely covered by the fibrous capsule, a thin, translucent but comparatively strong membrane. From it pass into the cortex delicate connective tissue fibres which are easily torn in the normal state. When the fibrous capsule reaches the hilum it passes over the outer wall of the papillæ and the calices of the pelvis and provides a thin layer to cover the renal blood-vessels to their respective sources. Posteriorly the extension of the fibrous capsule is much stronger and constitutes the so-called suspensory ligament of Englisch. Part of it merges with the sheath of the aorta and part is continuous with the fascia covering the lumbar origin of the diaphragm.

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The subperitoneal tissue in the region of the kidney forms a distinct fascia, the fascia renalis, which divides at the convexity into an anterior and posterior layer. The anterior passes in front of the kidney, the renal vessels, and the ureter to the other side of the body in front of the great vessels. It is better developed over the left kidney. Above the upper pole it fuses with the posterior layer and the united fascia is lost over the diaphragm. The posterior layer passes behind the kidney and over the fascia covering the transversalis, quadratus lumborum, and psoas muscles to the vertebral fascia. At the inner margin of each of these muscles the attachments are quite strong, and this also serves as an important element in the support of the kidney. At all points the renal fascia is separated from the fibrous capsule by the fatty capsule, but scattered connective tissue bands pass through the fat from one to the other. Inferiorly, while the anterior and posterior layers of the renal fascia approach each other, they do not join but separately disappear in the loose areolar tissue of the iliac region.

The fatty capsule is an envelope of adipose tissue found between the renal fascia and the intimate fibrous capsule of the kidney. Its distribution is not even, since the fat is relatively thin about the upper half of the kidney, accumulates at the hilum, is fairly abundant about the lower end, and is thickest over the posterior aspect of the lower pole at a point nearest the surface of the body. As its purpose is presumably protective the reason for this arrangement is obvious. The fatty capsule is not found at birth and is more or less deficient until puberty; it varies somewhat in amount in different persons and largely disappears during emaciation. The blood-supply is derived from two arteries given off from the renal artery just before or just after it divides, and from a branch of the first lumbar artery. All three are very small and surgeons are familiar with the slight bleeding encountered in the fatty capsule in operative procedures.

The lymphatic circulation is made up of three networks,—one in the cortical portion, one situated immediately beneath the fibrous capsule, and one beneath the peritoneum in the superficial portion of the adipose capsule. The efferents from the cortical network pass through the medullary substance and emerge at the hilum in several vessels which pass along the renal vein to the upper nodes of the lateral lumbar group. The network beneath the fibrous capsule communicates both with the cortical and subserous networks and drainage is probably by the two routes in equal degree. A few vessels also pass around the kidney beneath the capsule to the cortical terminals. The subserous network drains into the upper lateral lumbar nodes independently of the cortical efferents; it lies in the pathway of, and is a part of, the lateral lymph drainage system. The lumbar lymphatic nodes are from twenty to thirty in number and form three irregular longitudinal rows along the abdominal aorta. They extend from the second lumbar vertebra to the bifurcation of the aorta and with the communicating vessels form the lumbar plexus. Without describing in detail the arrangement and precise location of these nodes it is important to note two points. First, that the median row drains, either directly or through the mesocolic nodes, the entire lymphatic flow of the large intestine except the cæcum and appendix, which sends efferents to the mesenteric nodes. Second, that the lateral rows receive drainage from the kidneys, suprarenals and posterior abdominal walls,—from the iliac and through them the inguinal nodes,—from the bladder,—from the testicles, penis, and prostate gland in the male,—from the clitoris, and portions of the vagina and uterus in the female,—and from the adjacent subserous tissues.

From the foregoing hasty compilation of the known anatomy of the perinephrium, certain deductions may be drawn. At once the fact presents itself that we are dealing with an area of fat which is bounded on all sides by connective tissue layers of relative imperviousness, viscerally by the fibrous capsule, externally by the renal fascia. The only lapse is below where the two layers of the renal fascia are lost separately in the iliac fascia. Adipose tissue generally throughout the body is indifferently nourished compared to other structures. Here this is particularly true since the circulation is dependent upon three tiny arteries, the largest of which is scarcely the size of a knitting-needle. And, furthermore, it is evident that the connective tissue coverings are not such as to readily permit of an emergency increase in blood-supply to combat infection. On the other hand, the lymphatic arrangement in this neighborhood is highly suggestive in offering explanations of perinephric suppuration. The cortical network probably does not concern the immediate subject, but the network beneath the fibrous capsule and the subserous group of lymph vessels undoubtedly provide channels through which infection passes to the perinephrium, and with these the relation of the lateral lumbar nodes and collateral vessels to the adipose capsule should be taken into consideration. Were it not for the fact that the communication between the subcapsular and subserous networks is free and abundant, it is likely that perinephric suppuration would never get its infective impetus from the kidney except in the rare instance of a calculus penetrating the parenchyma, or pelvic wall. As it is, the renal origin of perinephric abscess is well recognized, and pyelitis, pyelonephritis, pyonephrosis, and acute hematogenous infection of the kidney are all assigned important places in the causation of this disease. Undoubtedly the route taken by infection may be through the intercommunicating vessels between the two networks, but the phase of a quicker access to the adipose capsule through sudden small tears or rupture should be considered. To the writer the latter solution seems quite reasonable, at least in the chronic forms of renal infection, since the effect of inflammation upon the fibrous capsule is much the same as it is on the peritoneal covering, namely, to cause thickening with hardening and thereby tending to block the lymph channels. Many pus kidneys are seen which never have given rise to extraneous suppuration and the contrary is the exception rather than the rule.

Admitting that some perinephric abscesses start from an adjacent diseased kidney, I want to call attention to what seems to me a far more frequent cause. The usual history in these cases is that a patient of about thirty years of age is taken ill with pain in the lumbar region, associated with some fever, with stiffness of the back, and occasionally with a tendency to flex the corresponding thigh. In a short time evidences of abscess appear in the deep structures about the kidney. On prompt evacuation of the pus the patient quickly gets well and returns to work none the worse for the experience. The urine is usually normal, or, at the most, only shows the changes incidental to fever from any cause, and the kidney at operation appears to be unaffected. What is there in this picture to make us assume that the responsible infection came through the kidney? Why ignore the recognized tendency of all infections to travel by the lymph channels, and to overlook the vast area below the kidney for portals of entry? Already attention has been directed to the anatomical reasons for an area of lessened resistance in the fatty capsule, and the intimate relation of the subserous network to the lateral lumbar nodes and to the contributing lymph channels has been mentioned. It seems fair to assume that any infection which affects the lateral nodes has potentially the power of creating perinephric abscess. Etiologically the bacterial invasion may occur at any point along the lymphatic drainage of certain defined areas. Of these probably the most important is the lower genito-urinary tract. A number of instances have been reported where there was an antecedent infection of the urethra or prostate, or where infections of the testes or the cord have been followed by perinephric suppuration. In women portions of the vagina and uterus may transmit bacteria to the adipose tissue through the lymphatics. Horsley recently has reported in detail three cases occurring in women after parturition, and Hirst noted a case following infection after abortion. Furthermore, it should be borne in mind that bladder infections may be responsible without an ascending infection through the kidney. The posterior abdominal wall can be another direct source of infection, and, finally, any of the lymphatic vessels draining into the iliac nodes may serve to carry micro-organisms within the perinephric zone.

With this extensive drainage area there are opportunities for infection without recognition of the exact avenue through which it came, and a brief reference to the literature will show that many cases are assigned to unknown causes. When the difficulty of determining the source of infection in adenitis of the groin, axilla, neck, or elsewhere, is considered, and when it is realized that with these the point of invasion is often inconspicuous or not found, it seems reasonable to apply the analogy to the deeper lymphatics and to conclude that many perinephric abscesses of unrecognized source must have their origin from the lymphatic system below the kidney. That more of these abscesses are not observed is doubtless due to the well-known fact that the lymph nodes, generally speaking, destroy the micro-organisms in transit and it is only in the exceptional case that infective agents get near the perinephrium.

While it is unwise to state that any infection of the abdomino-pelvic cavity may not give rise to perinephric suppuration, yet there are a number of conditions which have been held responsible for which there is insufficient anatomical basis. I refer to such diseases as appendicitis, cholecystitis, abscess of the liver, spleen, or pancreas, and ulcerative colitis. Each and all of these may cause subphrenic or subdiaphragmatic abscess but hardly perinephric abscess. The reason is clear since the drainage from these tracts is into the median row of the lumbar nodes and hence traverses a route relatively remote from the adipose capsule. Of course an exception must be made where any of these diseases cause a suppuration involving the posterior subperitoneal tissues, and possibly a special exception should be made to cover those portions of the colon which are in direct contact with the kidney, where the law of continuity would prevail. It has also been stated that abscess of the lung and empyema may occasion perinephric abscess. Nearly forty years ago Bowditch called attention to the rather decided tendency to secondary pulmonary involvement and his observations have been confirmed by other writers (this complication is well illustrated in the present series). The solution lies in the situation of the upper lateral lumbar nodes upon the crus of the diaphragm which is penetrated by their efferents passing to the thoracic duct. That pleurisy, pneumonia, and empyema may readily follow perinephric abscess is true, but the upward flow of drainage would render the reverse extremely questionable. Doubtless some perinephric cases are not recognized until there is an associated pleurisy or empyema and the result has been assumed to be the cause.

There is still a class of cases which do not fit in with those of renal origin or those having a more remote source through the drainage system. I refer to the few cases which are apparently due to hematogenous infection, such as those following typhoid, measles, influenza, or peripheral suppurations. We are familiar with the pathological proposition that the blood can carry micro-organisms under certain conditions, but the details of this proposition and the relation it may bear to perinephric abscess are still beyond our knowledge. The hypothesis has been advanced that by reason of the large amount of blood passing through the kidney and its peculiar structures, there is a tendency toward lodgment of bacteria and their escape into the perinephrium without renal lesion. I have not been greatly impressed by this theory since it would seem that the same doctrine might apply with equal force to the spleen or liver. Furthermore, it is of interest to recall that in conditions where we know the blood contains bacteria, such as tuberculosis, perinephric suppuration does not occur without prior involvement of the kidney; or again in septicopyemia where often both blood and urine are loaded with bacteria perinephric abscess is unknown. There are as good or even better reasons why infection should pass directly to the adipose capsule by its own vessels, and therefore it is well to conclude that while a small percentage of cases apparently are hematogenous, yet the exact route the infection takes is unknown.

Cold, over-exertion, and trauma were considered prominently by the older writers among the causes. In the light of modern pathology we can afford to ignore the first two, but trauma would certainly seem to occupy a place as an important contributing factor. In many cases there is a clear history of injury to the back and inferentially the same conclusion may be reached in other ways. The greater proportion of men over women with the greater likelihood of injury to the former, the common occurrence during the years of greatest physical activity, the predominance of right-sided abscess over left-sided, due to the lower position of the right kidney, and the frequent early localization of the pus in the fat covering the lower pole posteriorly, all strongly suggest that external violence plays a contributing part. The rarity of the disease in children, who naturally are exposed to injuries, is doubtless explained by the absence or scanty development of the perinephric fat. Cumston thinks that children pay a severe penalty for the exemption in their greater predisposition to neoplasms. The relation of injury as well as the hematogenous source of the infection was shown experimentally many years ago by Albarran, who injected pyogenic bacteria into the ear of a rabbit, then bruised the perirenal tissues, and caused artificially an abscess.

The relative proportion of cases due to renal disease to those having an infectious source elsewhere is an interesting question and one which possesses practical importance. Of late there seems to be a tendency to emphasize the renal origin. Ransohoff in a recent admirable article on the surgery of the kidney, in speaking of perinephric abscess, says that "suppurations within the perirenal fat are for the most part due to suppurative disease within the kidney resulting from calculous pyelitis, tuberculosis, or metastatic abscess," and later quotes Israel's series of forty-three cases, in twenty-one of which the disease was consequent upon stone, pyelitis, or tuberculosis, and in thirty-four of which the kidney was involved. Guiteras believes that nearly all cases are due to disease of the kidney and has reported fifteen cases, fourteen of which he assigns to renal causes. Upon these were done eight nephrotomies, four nephrectomies, and one partial nephrectomy with three deaths. I may say in passing that a critical analysis of his reports discloses six cases in which a reasonable doubt may be raised as to the source of infection. On the other hand the collections made by other writers and the general text-book teaching would tend to show that the cases of renal origin comprise not over a third of the total number. In Küster's comprehensive series of two hundred and thirty cases, fifty-nine, or about 26 per cent., were due to suppuration in the kidney. Among the cases herewith reported I have been able to include only four cases of renal origin, two of which are certain and two are probable. In making up this series I have collected from a majority of the largest hospitals in Philadelphia all the cases I could find (except two or three where the records were very inadequate) over a period of four or five years. It may be that a few cases were classified under the more dominant kidney lesion and hence overlooked in the search, but certain it is that from this collection there is no ground to conclude the proportion of cases due to renal infection to be greater than 20 per cent., if that high.

This question cannot be lightly dismissed on account of its bearing on treatment and prognosis. If we are to assume that perinephric suppuration spells renal disease in the great majority of cases, it naturally leads to a thorough search for the underlying renal cause. This is not warranted if these abscesses are, in the main, simple affairs requiring only early recognition, free evacuation, and drainage. It is beyond question that the type of abscess which occurs secondarily to renal infection is a serious malady and has a high mortality, probably in the neighborhood of 40 per cent. Nephrotomy or nephrectomy is usually indicated, either at once or, if possible, at a later afebrile period with material lessening of the risk to life. My contention is that this form is not the ordinary one and does not comprise more than a fourth to a fifth of the total number. In the commoner type where the infection comes from the drainage area below the kidney, or from hematogenous sources, the mortality is comparatively low under modern surgical treatment, apparently approximating 10 per cent., and even this mortality is largely due to the pulmonary complications to which the disease is so prone.

It should be possible in most cases to differentiate between the two forms. The history of prior attacks of renal colic, or frequent alterations in the quantity or quality of the urine, or the detailing of symptoms indicative of chronic cystitis should arouse suspicion of the renal source of infection in any case of perinephric abscess. Some attention should be paid to the greater average age of patients suffering from this type of abscess. Further valuable data may be obtained by careful examinations of the whole urine and of separated specimens obtained by ureteral catheterization, even carrying the investigation to the point of learning the bacterial contents of the urine from each kidney. The skiagraph can be generally relied on to show stone, and the recent reactive tests for tuberculosis might be applied in any suspected case, guarding of course against an existing tubercular focus elsewhere in the body. Finally, if the case reaches the operating table without a definite diagnosis beyond that of perinephric abscess, the presence of a causative and material lesion in the kidney may be shown by the admixture of urine with the pus, the existence of sinuses leading into the cortex or pelvis, the occurrence of a free or partly free calculus in the abscess cavity, or the gross alteration in size and shape of the kidney.

It is not my intention to discuss the general symptomatology, since the important clinical phenomena associated with perinephric abscess are too well known to warrant repetition.

However, as it sometimes happens that the correct and prompt diagnosis is difficult, or perhaps not made until too obvious for error, I want to call your attention to two observations which may throw light upon the doubtful case. That such difficult cases occur is well shown in the present series where one case was treated as typhoid fever for nearly a month despite a rising leucocytosis before correctly interpreted; another was operated on for acute appendicitis and the mistake not rectified until the continuance and augmentation of the symptoms caused the surgeon to operate again; and in four cases the abdomen was opened transperitoneally in an evident hazy state of mind of the operator as to the true condition. And these cases occurred in the services of skilled and experienced surgeons whose examinations were doubtless checked by alert hospital internes.

The first observation which I wish to emphasize is the existence of a fixed point of greatest tenderness in cases of perinephric abscess over the fascial triangle of Grynfelt and Lesshaft, or as I prefer to call it the kidney triangle, bounded by the erector spinæ, the twelfth rib, and the internal oblique. Just as there is more or less muscle stiffness and referred pain in appendicitis but with a constant area of maximum tenderness at or near McBurney's point, so I believe we have in perinephric abscess the same phenomena with reference to the kidney triangle. This is the place where the kidney is nearest to the surface of the body and it makes no difference whether the abscess lies in its usual primary location, over the lower pole posteriorly, or whether it is affected indirectly through the substance of the kidney, the response to pressure at this point is instantaneous and characteristic. By reason of the relations to the lumbar plexus of nerves the reference of pain is exceedingly common in these cases, and as muscular rigidity may cover so wide an area it may be well to bear in mind this triangle in routine examinations. I do not wish to urge the phenomena as pathognomonic since a limited experience has taught me to regard it as of value in all inflammatory diseases of the kidney, but not to the same extent as in perinephric abscess. Brewer speaks of tenderness in the costovertebral angle as a pathognomonic sign in acute hematogenous infection of the kidney, and doubtless some surgeons have noted it in relation to other surgical diseases of the kidney but the fact remains that its significance has not been generally recognized.

The second diagnostic point is one apparently of great interest and importance, but at this time I offer it more or less tentatively as to definite conclusions. I refer to the exceptionally high leucocytosis found in perinephric suppuration. In twenty-three cases of this series the blood count is recorded more or less completely, and at once it will be seen that without exception the number of white blood corpuscles is high—in the lowest 11,700, in the highest 48,800, with a general average of 24,700. It is generally known that the chronic infections of the kidney give a low leucocytosis, and I am under the impression that in the acute suppurations of the kidney proper the increase of white cells does not approach such a high average, but whether this factor is constant enough to be of positive value in differential diagnosis requires further investigation. The only reference so far found is that given by Emerson, who noted in five cases of perirenal abscess the leucocytes to range from 19,000 to 36,000, in four cases of pyelitis from 10,000 to 19,500, in two cases of pyelonephrosis from 18,000 to 28,500, and in two cases of hydronephrosis from 6,400 to 9,000.

CASE REPORTS.

Case I. Pennsylvania Hospital, 140 ('08).—G. L., aged 24, stone mason, native of Italy. Admitted March 6, 1908; discharged July 9, 1908. Family and previous history uninteresting, except that he had pneumonia on the left side two years before admission.

Present illness began 25 days ago with a hard cough and 15 days later he noticed a tumor in the abdomen which has not increased in size since he first found it. He has slight pain in the mass when he coughs. Bowel movements normal and not painful; urine seems normal in amount and no pain on micturition. No loss of weight or strength; no pain in walking; no pain in back except when he turns in bed.

In the lower left quadrant is a moderately large, tense, and smooth tumor. It is fixed and immovable, not influenced by respiration, not connected with the spleen. Urine 1024, trace of albumin, a few hyaline casts, epithelial cells and debris. Leucocytes 16,600, hæmoglobin 77 per cent., no malarial organisms. March 17, 1908, leucocytes 11,150; repeated urine examinations show no change. March 20, 1908, cystoscopic examination was done and a ureteral catheter introduced into the pelvis of the left kidney. Urine secreted in 3.35 hours was 2½ ounces. Examination of this urine gave sp. gr. 1025, trace of albumin, no casts, no pus.

Operation, March 24, 1908, by abdominal incision and a large, fluctuating round tumor was found back of the peritoneum on the left side. It was not connected with the spleen or kidney. Abdominal contents were normal and the wound closed. By posterior incision the abscess was opened and about two pints of greenish-yellow pus were evacuated. The laboratory report shows no organisms of any kind by smears or cultures.

Practically the temperature was slightly subnormal throughout. Convalescence was prolonged by depth of sinus and slowness of healing, but he was discharged as well July 9, 1908.

Comment.—No urinary symptoms, no pain in walking; cough showed slight pulmonary involvement; temperature subnormal throughout; diagnosis not clear until operation which was first by anterior incision, then posterior for drainage.

CASE II. Pennsylvania Hospital, 133 ('08).—S. A., aged 22, negress, domestic. Admitted March 25, 1908; discharged May 6, 1908. The history shows smallpox six years before admission, also syphilis three years ago. With present illness she has been sick two months and in bed two weeks, complaining of pain in both iliac regions, of fever but no chills, of pain and burning with urination, and of pain with bowel movements. Has had slight cough and expectoration. No history of injury and no evidence of pelvic infection except that suggested by a profuse vaginal discharge. Notes do not show results of physical examination except the presence of a secondary skin eruption.

April 6, 1908. Complained of pain in the right side about the lower chest and upper part of the lumbar region. Two days later a large, smooth swelling was slightly perceptible in the right lumbar region. This side of the abdomen was rigid, tender, and an indefinite mass could be made out. Leucocytes 44,550. Urine, sp. gr. 1030, faint trace of albumin, many white blood corpuscles, and a few granular and hyaline casts.

April 9, 1908. By lumbar incision a large quantity of foul smelling, dark colored pus, with gas bubbles in it, was drained. No bacteriological report; recovery uneventful. Temperature range was irregular but not above 101 degrees. The leucocyte counts subsequent to operation were as follows: April 10, 46,700. April 13, 15,000. April 17, 7650.

Comment.—Source here may have been through the skin eruption, or from the pelvic organs; urine showed trace of albumin and a few casts but nothing to suggest infected kidney; high leucocytosis; irregular fever up to 101 degrees.

CASE III. Pennsylvania Hospital, 239 ('08).—J. D. M., aged 11, native of Italy. Admitted April 13, 1908; discharged July 18, 1908. Past history negative; ill 55 days with pain over left kidney and later swelling; no chills or sweating; voids urine normally; no œdema of lower limbs. Small, thin, anæmic boy; temperature 100 4/5 degrees, pulse 140, respiration 32; distinct tenderness over left lumbar region; soft fluctuating tumor; local redness and some œdema. Urine: Acid, sp. gr. 1025, trace of albumin, no casts, few epithelial cells and leucocytes, a morphous urates, phosphates, and debris. Hæmoglobin 50 per cent., white blood corpuscles 38,500.

April 15, 1908. Incision in left flank and considerable quantity of greenish-yellow rather thick pus evacuated. Cavity extended toward spine but there was no caries. Bacteriologically the cultures showed pure staphylococci.

July 18, 1908. Discharged but sinus still running.

August 8, 1908. Returned from Atlantic City, examined and found well. Temperature range was irregular, running from normal to 101 degrees.

Comment.—A staphylococcus infection of unknown source in a lad of 11 years; urine practically normal; temperature range irregular up to 101 degrees; high leucocytosis.

Case IV. Pennsylvania Hospital, 1546 ('07).—E. F., aged 23, negro, laborer. Admitted August 28, 1907; discharged October 30, 1907. He gave a history of having fallen off a trolley car three weeks before and having had since then severe pain in the left side with difficulty in the commencement of the act of micturition. After his fall he stopped work for two days, then worked five days, but by that time the pain had become so severe that he could not lace his shoes or walk erect. The muscles in the left lumbar region were very painful and this pain radiated through the left side of the abdomen to the umbilicus. He has had slight cough with yellowish sputum which sometimes has been tinged with blood. Has had fever but no chills.

Somewhat thin, rather anæmic man; bodily movements affecting the trunk apparently painful. Temperature 102 3/5 degrees, pulse 90, respiration 24. Chest expansion equal but over the lower left lung the breath sounds suppressed and note impaired. Heart, liver and spleen normal. Abdomen showed no distention but it is tender over the left side, from the costal margin to the iliac crest. No tumor made out. Urine, clear, faintly acid, 1030, trace of albumin, one or two faintly granular casts. Leucocytes 30,350, hemoglobin 92 per cent. Urine from ureteral catheterization of the left kidney showed normal amount and only 3 or 4 red cells. Sputum gave no tubercle bacilli. Operation on August 30, 1907, by incision parallel to the spine which opened a large perinephric abscess. Temperature was normal two days later and no fever appeared subsequently. The sinus continued to discharge for a long time and he was not discharged until October 30, 1907. Even at that time he continued to complain of a little pain in the left lumbar region.

Comment.—Trauma may have been a factor in this case but on the other hand it may have served only to call his attention to his malady; cough and pulmonary involvement on same side as the abscess; temperature about 102 degrees, but promptly fell to normal when abscess was opened.

Case V. Polyclinic Hospital, 17632.—F. D., aged 18, negro, concrete worker. Admitted August 17, 1909; discharged September 6, 1909. family and previous histories were negative. Two months before admission had a punctured wound of left index finger which became infected and was opened; later necrosis of distal phalanx developed and it was removed. Two weeks prior to admission he commenced to have pain in the right flank which was worse on walking or when he would try to lie on that side.

Lightly muscled but generally well developed young negro. Lips dry, tongue coated, index finger of left hand suppurating. Pain was localized on the right side below the rib edges and outside the erector spinæ. Temperature 101 2/5 degrees. Heart and lungs normal; no cough. Chest movements were equal but the abdominal muscles moved more on the left side. No tenderness over the stomach, liver, appendix, or pelvis; no rigidity of the recti. Outside of the semilunar line and above the umbilical level there was decided muscle stiffness and a quick response to pressure. Tenderness marked from the crest of the ilium to the rib edges and its acme was at the kidney triangle. Indistinctly a mass could be felt. Blood showed leucocytes 18,200, erythrocytes 3,800,000, hemoglobin 60 per cent. Urine was normal in all respects.

On August 21, 1909, under ether anæsthesia an oblique incision was made over the right kidney and about an ounce of creamy pus was evacuated. The abscess was in the fatty capsule and was posterior to the lower pole of the kidney. The pus showed staphylococci. Recovery was uneventful. Temperature range was about 101 degrees but it dropped to normal six days after operation.

Comment.—Source of infection probably hematogenous from felon of left index finger; urine normal; temperature range was about 101 degrees.

Case VI. Polyclinic Hospital.—J. P. F., aged 35, native of Russia. Admitted April 27, 1903; died May 7, 1903. Married 16 years with 7 children; now pregnant in third month; seven years ago after childbirth had "inward trouble but has been well some time." Present trouble began six months ago with pain in right side below costal line and posterior to mid-axillary line which gradually grew worse; went to bed three weeks ago; a swelling in this location developed eight days ago. History was defective as patient could talk English very indifferently.

Heart and lungs normal. Abdomen very tender on right side between costal margin and crest of ilium in axillary line, where a hard mass was palpable which extended apparently backward. Temperature 99 degrees, pulse 80, respiration 20. Urine, weakly acid, 1022, albumin present, red and white blood cells, no casts. Leucocytes, 28,000.

April 29, 1903. Incision over right kidney and a large quantity of pus was evacuated: abscess cavity seemed to point in the direction of the appendix; kidney apparently uninvolved. Gauze and tube drainage. Bacteriological examination showed the only organism was a typical growth of streptococcus pyogenes.

April 30, 1903. Without chill developed within 24 hours of operation pleural friction sounds over anterior surface of right lung with fine râles in the lung; progressed into typical pleuro-pneumonia of entire lung. Died May 7, 1903; no autopsy. No local developments in the kidney area beyond some foul smelling discharge.

Comment.—A streptococcus infection of unknown origin, possibly pelvic; urine showed nothing significant; within 24 hours of operation patient developed pleuro-pneumonia of corresponding side and died 8 days later.

Case VII. Presbyterian Hospital, 37731.—P. L., aged 39, native of Ireland, fireman. Admitted October 26, 1906; discharge January 31, 1907. Illness began a week before admission with symptoms suggesting typhoid fever but he also had severe pain in the right side posteriorly and laterally below the costal margin. There was no tenderness to pressure, no rigidity, no mass. His condition was diagnosed as typhoid fever. He continued to complain of pain in the region of the right kidney and a month later it was noted that this area was prominent; there was tenderness and rigidity and a mass could be felt at the lower margin of the ribs. In a day or two fluctuation could be felt and it was noted that he lay with his right thigh flexed and efforts to extend it caused increased pain. Temperature range was between 101 degrees and 102 degrees. Blood count showed a leucocytosis as follows: October 28, 8,800; November 12, 13,600; November 26, 15,200. Urine was normal throughout except once a few hyaline casts were seen. On November 28, 1906 an incision was made into the abscess and over twenty ounces of pus liberated. The abscess cavity ran down to the kidney and another part ran upward and backward. The kidney was palpated and found not enlarged. Three days after operation temperature had reached normal and subsequently there was no fever. Convalescence was slow and he was not well until January 31, 1907.

Comment.—A case diagnosed and treated as typhoid fever for a month despite a rising leucocytosis; no urinary changes and kidney found unaffected at operation.

Case VIII. Presbyterian Hospital, 37344.—T. E., aged 49, native of Italy. Admitted September 27, 1906; discharged October 3, 1906. Family history was negative; married and father of 3 children; chancre 23 years ago; also had malaria with jaundice, tender liver and enlarged spleen. Present illness began September 4, 1906 with fever, chill, and sweat. Had severe pain in the lower right side of back which was later felt down the thigh and leg like a sciatica. On admission complained of severe pain in the right renal region and down the leg in the course of the sciatic nerve. He was found to have pronounced rigidity and exquisite tenderness in right lumbar space, from costal margin to pelvic crest. Attempts to flex the thigh were resisted and apparently caused great pain. There was lateral curvature of the spine with concavity toward the affected side. No kyphosis or spinal tenderness. Urine was normal; leucocytes, 29,600. Refused operation and was discharged unimproved.

Comment.—A case of undoubted perinephric abscess which declined operation; urine normal; high leucocytosis; pain was mainly referred to the sciatic area and efforts to flex the thigh were resisted.

CASE IX. Presbyterian Hospital, 39146.—K. M., aged 52, female, native of Pennsylvania. Admitted July 22, 1907; discharged October 5, 1907. Married and mother of 7 children. Two weeks before admission she had an attack of indigestion with severe pain under the heart; indigestion persisted but she worked until the evening before she applied to the hospital, when she was taken ill with pain under the right breast, getting worse and gradually involving the entire right side. The pain was continuous and uniform in character; it commenced high but on admission patient referred it to a point to the right of the umbilicus. Full inspiration caused increase of pain at the lower margin of the thorax, and she described the pain as being "like a boil."

Examination: Abdomen distended, large and flat; patient on right side and in that position a tumor on the right side could be felt, its border extending two inches to the left of the umbilicus. No jaundice, no œdema. Vaginal and rectal examinations negative.

August 4, 1907. The pain was generally located in the right hypochondrium and slightly below the umbilical line. The tumor was cystic and thought to be gall bladder. Temperature range from 100 degrees to 102 degrees. Patient tended to turn in bed toward the right side.

Operation on August 5, 1907 when a vertical incision was made through the right rectus exposing a large perinephric abscess. This was opened through greatly thickened peritoneum and about two quarts of pultaceous material in sero-sanguineous pus was evacuated. The color was dark like decomposed blood. The cavity extended to right kidney which was of normal size. The temperature dropped in 48 hours from 103 degrees to 98 degrees.

August 24, 1907. Patient developed congestion of base of right lung with pleurisy which cleared up by September 2, 1907. Convalescence was delayed by an attack of cystitis which appeared September 8, 1907, and she was not discharged until October 5, 1907, and at that time she was entirely well.

Repeated urine examinations were negative until August 22, 1907, when some epithelial cells and numerous leucocytes were noted and on the development of cystitis the usual urinary findings were noted, but at no time were there any casts. No blood examination and no report on the pus.

Comment.—Transperitoneal opening of a large abscess; diagnosis difficult; kidney not affected and urine normal; convalescence delayed by pulmonary congestion and a late attack of cystitis.

CASE X. Presbyterian Hospital, 26433.—A. S., laborer, aged 39, native of Italy. Admitted November 8, 1901; discharged January 11, 1902. His previous history showed that three years before his admission he had been treated in the dispensary for an injury to the left side as the result of being struck by an engine. Further than this he has been strong and healthy.

Present illness began twelve days ago with pain in the abdomen, especially in the epigastrium; no gastro-intestinal phenomena; no chill or fever. He felt somewhat better after the first attack of pain, but three days before admission he "chinned" himself three or four times on a door. This markedly increased his pain and it became definitely located on the left side about the base of the chest. With this he has had dyspnœa and a slight cough. Bowels have been constipated.

Examination showed on the left side from the midaxillary line to the vertebral column and to the lower margin of the ribs, an area of dullness the size of the palm. This area was tender on pressure but no œdema was present and no fluctuation made out. There was some congestion of the base of the left lung. Leucocytes, 16,800. Urine showed very few leucocytes, no red corpuscles, trace of albumin, and a few hyaline and granular casts were found with the centrifuge only.

November 18, 1901. Leucocytes, 15,800. Apparent deep seated fluctuation in the lumbar region of the left side; complained of some pain.

November 21, 1901. Dr. Willard made an oblique lumbar incision over the involved area. Nothing abnormal was found until the perinephric fat was reached, when a large abscess was opened and considerable quantity of "laudable" pus was drained; no involvement of the kidney. Bacteriological examination of the pus gave abundant staphylococci and an unidentified bacillus. Temperature chart showed slight fever, 99 degrees to 100 degrees, until two days after operation, when it dropped to normal. Discharged, well January 11, 1902.

Comment.—Urine practically normal; pulmonary phenomena; pus showed staphylococci and an unidentified bacillus.

Case XI. German Hospital.—P. W., male, aged 25 railroader. Admitted July 14, 1909; discharged August 17, 1908. Nothing of note in his previous health except five years before he had had an attack of rheumatism. A month prior to admission was taken ill with severe pain in the right lumbar region; the pain was dull and burning, never cutting, and it did not radiate; constantly present but varied in intensity; had no vomiting and no urinary disturbances. The only physical sign was excessive tenderness in the right lumbar region; no mass felt. On July 18, under ether, a quantity of foul smelling pus was evacuated from an abscess about the lower pole of the kidney. Temperature range was about 100 degrees, quickly falling to normal after the operation. Urine was normal in amount and specific gravity; no pus was found, and, aside from a very few hyaline casts, it was normal in all respects. Ureteral catheterization showed no difference in the urine from the right and left kidney. Leucocytes, 14,520. Pus showed bacillus coli commune as the principal organism.

Comment.—B. coli commune infection of unknown origin.

Case XII. German Hospital.—A. E., male, aged 26, knitter. Admitted September 8, 1908; discharged October 1, 1908. For three weeks prior to applying to the hospital he had had constant dull pain in the left lumbar region, gradually getting worse and preventing sleep. No radiation of the pain. Examination showed in the left kidney region distinct bulging with marked tenderness but no definite mass could be felt. Three days after admission a large pocket of pus was opened by vertical incision over the left kidney. The abscess lay posterior to the kidney which was not involved. There were numerous careful urine examinations in this case but aside from a very faint trace of albumin, a few hyaline casts on one occasion, and a few pus cells seen four days after operation, there was nothing abnormal. The temperature range was between 99 degrees and 100 degrees until the abscess was opened. The leucocytes were 34,600. Pus showed staphylococcus albus.

Comment.—High leucocytosis; infective agent was the staphylococcus albus; urine practically normal.

CASE XIII. German Hospital.—T. L., aged 40, groceryman. Admitted December 31, 1907; discharged January 18, 1908. There was nothing of interest in his family, previous or personal history. Three weeks before admission he was seized with sharp, sticking pain in the left lumbar region; this was aggravated on motion or deep inspiration and radiated across the belly and to the spine; it was tender to pressure. There was marked tenderness over an area 10 cm. in diameter, situated posterior to the posterior axillary line from the rib margins to the crest of the ilium, with some rigidity of the muscles; much tenderness was present on deep palpation below the ribs and a sense of resistance was encountered at a point corresponding to the left kidney. Two days later under ether anæsthesia an abscess cavity surrounding the kidney was opened and 300 c.c. of reddish, foul smelling pus was liberated. This contained bacillus coli commune. Temperature ranged from normal to 101 degrees until the operation, when it became normal. Urine on four examinations showed a very faint trace of albumin, two granular casts, a very few leucocytes, no pus, and was acid in reaction. Leucocytes, 11,700; polynuclears, 89.5 per cent. Convalescence uneventful.

Comment.—Urinary findings unimportant; no ascertainable cause; infective organism bacillus coli commune; temperature from normal to 101 degrees.

CASE XIV. Presbyterian Hospital, 36 ('09).—A. D., aged 50, housewife. Admitted June 18, 1909; died July 17, 1909. This patient was first treated at the hospital from May 7, 1908 to June 11, 1908 for hemorrhoids and cystitis and underwent the clamp and cautery operation. She returned and was under treatment from January 25, 1909 to February 11, 1909 for carbuncle and cystitis; again she was operated on, the carbuncle was excised and a ureteral stricture was dilated. Her third admission was on June 18, 1909, when she was found to have a large mass in the region of the right kidney with a reddened and œdematous area in the flank. The following day an incision opened a large abscess containing about two quarts of foul pus. It is unfortunate that the notes in this case are not full. On July 9, 1909 a sinus was opened down to the kidney and a secondary incision was made above Poupart's ligament but efforts failed and she died July 17, 1909. The temperature was practically subnormal throughout. Urine on six examinations was alkaline, with large quantity of sediment, albumin always present, large amount of pus, large number of red and white blood corpuscles; later there were fewer whites and an increase of reds.

The autopsy showed a hypertrophied kidney with a suppurating ureter the size of the little finger; perinephric suppuration; pyonephrosis and calculus; bladder seat of chronic cystitis and contracted.

Comment.—Perinephric abscess of renal source with clear history of urogenous infection; urinary reports characteristic of this form of perinephric suppuration; death followed an afebrile illness.

CASE XV. Philadelphia General Hospital.—M. R., male, aged 19, iron worker, native of Norway. Admitted March 8, 1906; discharged June 30, 1906. Complained of pain which was constant though in varying degrees and sometimes stabbing in character in region of the right kidney. It had affected him for about three months but getting slowly worse. Specific urethritis four months ago. Examination showed no chest abnormality; abdomen was slightly rigid in the right flank but no mass could be distinguished. Skiagraph showed no calculus or other distinguishable pathological condition. On March 31, 1906, under ether, about an ounce of yellowish white pus was evacuated from an area about the lower pole of the kidney. No defect of the renal surface of the pelvis could be made out. Leucocytes on March 28, 1906 were 16,200. Urine showed several granular casts, few red blood cells, few leucocytes, and urates. The pus contained streptococcus pyogenes. The wound granulated nicely and healed promptly.

About a month later he developed a prostatic abscess. The late notes are defective but apparently he still later developed laryngeal tuberculosis.

Comment.—An abscess due to streptococci from a mixed infection of the urethra; no evidence of kidney involvement.

CASE XVI. Philadelphia General Hospital.—T. S., male, aged 34, laborer. Admitted December 24, 1904; discharged February 13, 1905. Complained of throbbing pain in left lumbar region extending downward along the crest of the ilium to Poupart's ligament. Patient was well up to two weeks ago when the pain started in the groin, and it has since been severe enough to disable him. Nothing of note was found on general examination except a hard mass could be felt in the upper abdomen on the left side. Three examinations of the urine gave normal results.

On January 16, 1905, under ether, an abdominal incision was made through the right rectus, when the tumor was found to be retroperitoneal and behind the left kidney. This wound was closed and by a lumbar incision about a pint of pus was liberated. There was nothing abnormal about the kidney. The pus showed staphylococcus pyogenes aureus in pure culture. The temperature was remittent in type up to about 102 degrees, but it fell to normal the day after operation. The wound healed well and he was discharged February 13, 1905.

Comment.—An average case due to staphylococcus aureus infection of unknown source; urine normal.

Case XVII. Philadelphia General Hospital.—T. M., male, aged 59. Admitted June 20, 1909; died July 14, 1909. Entered the hospital complaining of pain in the right loin and gave a history of gonorrhœa some months before, followed by stricture. He stated that three weeks prior to admission he fell as a result of dizziness, striking his back; the next day he hurt his back again but applied a plaster and thought nothing more of it. However, the pain persisted and got worse, so he came to the hospital.

Examination showed marked arterio-sclerosis, weak and irregular heart action but no murmurs. There was marked rigidity and some redness and swelling of the right loin; the right knee was drawn up and the patient seemed unable to straighten it. The day after admission he had a bad attack of syncope with almost imperceptible pulse. The heart was found acutely dilated and the sounds were almost absent. The lungs showed fine râles in front and behind. Leucocytes were 13,500. Urine: specific gravity, 1010, albumin, few red blood cells, many pus cells, granular casts, amorphous urates and triple phosphates.

On June 22, 1909, under local anæsthesia, an abscess containing about two pints of pus was opened. This pus showed streptococci and pneumococci. His temperature dropped from 101–102 to normal but his pulse and respiratory rates remained up, urine secretion kept below 40 ounces, and he died on July 14, 1909 of myocarditis and cardiac dilatation.

Comment.—The pus in the urine would indicate that the abscess had a renal source; death was due to myocarditis but it was likely accelerated by the infection; the pneumococci and streptococci gave rise to no special phenomena; corresponding thigh was flexed.

Case XVIII. University Hospital.—E. L. W., female, aged 58. Admitted December 1, 1904; discharged January 27, 1905. Twelve years ago she began to have attacks of renal colic and suffered eighteen months; she then recovered and has been well until the present illness. Four weeks prior to admission she began to have pain which was then indefinitely located in the abdomen. Within 24 hours pain and tenderness became located in the left loin and left hypochondrium; it was dull, constant, worse on jarring, and with no radiation. She was worse and better for ten days. Then a fever of about 102 degree abated and for a week she was fairly comfortable with a temperature of about 100 degrees. During the last three days her fever has increased and the pain is worse. The urine has been persistently loaded with pus and a few red cells.

On admission the left loin tissues showed œdema, with tenderness too great to permit of deep palpation. Urine: Acid, 1022, trace of albumin, loaded with pus, and some columnar epithelium. An abscess containing about a quart of greenish pus was opened and found to extend toward the median line to the aorta and above and below the kidney about two inches. The kidney showed at the middle of its convex surface a sinus the size of a dime and at the lower pole there was another sinus. Probes passed through these entered the pelvis and touched. The upper pole was nearly normal and still showed some fat about it. After operation the urine contained much blood which soon disappeared; hyaline, granular, and pus casts, with many pus cells were observed. Urine drained through the back in free amount for a long time and the sinus was not closed on discharge. There was persistent cystitis during most of her stay at the hospital. Temperature was normal except during the first four days.

Comment.—A case of abscess having renal origin; two sinuses found in the kidney; persistent cystitis.

Case XIX. University Hospital.—S. S., male, aged 60, insurance agent. Admitted July 28, 1905; discharged August 16, 1905. Patient has had rheumatic attacks and thinks for about 25 years he has had "kidney trouble," characterized by pain in the back and frequent micturition. He dates his present trouble to an attack of grippe five months ago, but states the present trouble started two months ago when he noticed a small swelling on the back at the upper border of the ilium, on the right side. A week before admission a small swelling was also noted in the right groin. Has had pain in back and right hip and leg when he walks.

On examination a swelling about the crest of the ilium and upper sacrum was noted. It seems to have deep attachments but not to the spine or ilium. It was the centre of an area of induration about 4 by 6 inches. Urine, clear, 1020, no albumin, no sugar, few hyaline and granular casts. On July 29, 1905, incision along upper border of ilium showed many sinuses dissecting the muscle layers and apparently having perirenal origin. Another opening was made internal to the anterior iliac spine.

Patient was discharged on August 16, 1905, but re-admitted on September 14, 1905, with the observation that the sinuses had continued to discharge and two weeks before swelling was noted about the upper abdomen. Again he was operated on and this time the kidney area was thoroughly explored. Two quarts of flaky pus were evacuated from an area posterior to the kidney, which was found unaffected. Subsequently he developed cough and expectoration and chest examination showed still later that there was obliteration of the pleura from the sixth rib downward on the right side. Convalescence was slow. Pus showed staphylococcus aureus and albus.

Comment.—A case which might suggest renal origin; defective drainage caused a second operation; pulmonary complications; microorganisms were s. aureus and albus.

Case XX. University Hospital.—R. L., female, aged 45. Admitted October 26, 1903; discharged December 2, 1903. Gave an excellent previous and family history. Present illness began 12 days before admission with abdominal cramp, which she ascribed to the onset of the menstrual period; on the following day she went to bed with chills and fever; pain radiated from the right lumbar region to the left side of the body and hip; no jaundice but some vomiting. About a week later her physician noted a prominent mass in the right loin which was oval in shape and well defined. She could not straighten her right thigh or take a deep breath without excruciating pain. She was not aware of any alteration in the quantity or quality of the urine.

On admission the temperature was 103, pulse 104, respiration 26. Urine: Specific gravity 1032, cloudy, trace of albumin, granular casts, numerous white blood cells, no reds. Leucocytes, 26,940. Abdomen was distended but not tender; on right side extending from the rib borders to the pelvic brim, posteriorly to axillary line and anteriorly to an inch beyond the umbilicus, there could be felt on deep palpation a firm swelling which was not very tender. It was evidently covered by the intestines, and the size and position of the mass was unaffected by inflation of the colon. Pelvic examination showed a perineal and cervical tear, cystocele and prolapse.

Operation on October 31, 1903, and a large perinephric abscess drained; convalescence was uneventful. Pus contained the bacillus coli commune.

Comment.—The origin of the infection may have been pelvic; the infective agent was b. coli commune.

Case XXI. University Hospital.—H. A. G., male, aged 28, bookbinder. Admitted October 20, 1903; discharged November 1, 1903. Nothing of interest in previous, personal or family history. Present illness began about a month before admission, with dull pain in left upper lumbar region, principally under lower two or three ribs; two days later pain was markedly increased by a jolting ride and he went to bed; six days later a swelling in the upper lumbar region was noted; temperature was continuously elevated between 100 degrees and 101 degrees. On admission pain and tenderness were somewhat less than they were. No pleuritic symptoms, no gastro-intestinal disturbances, no alteration in urinary function.

Patient lay with thighs slightly flexed, spine bent a little both antero-posteriorly and laterally. Respirations hurried but no dyspnœa. Urine was normal in all respects. Left loin and lumbar region were the site of a resistant mass, extending from the pelvic brim up to and under the rib edges; whole area very sensitive, hot, and red; dullness from the nipple line to the spine; some bulging in the loin and swelling was very tense. Operated on immediately; quantity of pus not noted but it contained bacillus coli commune. Patient did well and wound was nearly healed when discharged. Temperature range was between 99 degrees and 100 degrees until three days after operation.

Comment.—No cause can be suggested; b. coli commune infection.

Case XXII. German Hospital.—J. W., male, aged 21, bookkeeper. Admitted February 15, 1907; discharged March 30, 1907. Was taken suddenly sick four days before admission with cramp-like pains about the umbilicus, was nauseated and vomited. Admitted to hospital with symptoms of acute appendicitis but also had rigidity of muscles in the right loin. At operation the next day the incision was made in the flank not opening the peritoneum. A large quantity of thin, malodorous, yellowish pus was evacuated from an abscess which extended upward above the kidney. Pus was found burrowing over toward the left side, the vena cava and ureter were exposed, and many pockets opened. No notes on the kidney condition. Urine examination showed very few changes from the normal. Pus gave the colon bacillus. On February 15, 1907 blood examination showed leucocytes, 16,500, polynuclears, 83.6 per cent., and on February 25, 1907 leucocytes were 13,400 and hæmaglobin 72 per cent. The temperature chart shows an even temperature of about 102 degrees until the sixth day, then a drop to 100 degrees and not reaching normal until March 8, 1907.

Comment.—Symptoms suggesting appendicitis with rapid onset and relatively high fever; urinary changes unimportant.

Case XXIII. German Hospital.—J. C. B., male, aged 32, lineman. Admitted May 17, 1907; discharged June 15, 1907. Gave history of specific urethritis ten years ago and chancroid two years ago. Present illness began one month before admission, with dull pain in right side, which continued and increased in severity. Later he had symptoms suggesting renal colic which were relieved by ice-bags.

No report of physical examination. Operation May 18, 1907, when an abscess was opened. Pus showed staphylococcus aureus. Temperature was practically normal. Urine showed a trace of albumin, a few casts, and a few leucocytes.

Comment.—Probably urethral infection by staphylococcus aureus.

Case XXIV. German Hospital.—S. L., female, aged 60. Admitted May 31, 1907; discharge July 3, 1907. She began to have cutting pain in left hypochondrium one month before admission, which was severe and increased on deep inspiration; it has been associated with irregular vomiting and constipation. Has had chills and fever and has lost about 15 pounds in weight, but has had no cough.

On examination an indurated, tender, slightly movable mass the size of a child's head was felt in the left hypochondrium and extending almost to the navel; it did not move with respiration. Operation June 10, 1907. Lumbar incision opened a small abscess containing thick, dirty yellow pus. Anterior to the kidney was an indurated and immovable mass which was not opened. A definite diagnosis was not made. The urine showed a constant trace of albumin with occasional granular casts and pus. Blood: On June 1, 1907, hæmaglobin 55 per cent., white blood corpuscles 19,200, red blood corpuscles 3,270,000, polynuclears 83 per cent. On June 5, 1907 the leucocytes were 23,300. The pus gave in culture the bacillus coli commune.

Comment.—It is probable that this case was one of pyonephrosis since she continued to have a slightly septic temperature until her discharge.

Case XXV. German Hospital.—J. McG., female, aged 18. Admitted June 12, 1907; discharge July 24, 1907. During three months prior to admission had dysmenorrhœa and for several months a yellowish vaginal discharge. Operated on by Dr. Deaver on day of admission for acute appendicitis, through an incision in the right loin; appendix found pointing upward and backward, deeply congested and covered by plastic exudate. After operation her temperature which was 103 degrees, dropped to 100 degrees, but almost at once it commenced to oscillate between 99 degrees and 103 degrees, gradually getting higher. It was found that there was great rigidity of the lumbar muscles and the right half of the abdomen. On account of the marked tenderness no mass could be felt. On June 29, 1907 Dr. Deaver again operated and through a lumbar incision opened and drained a perinephric abscess. Eight days later her temperature was normal and convalescence was uneventful. The leucocyte report was as follows: On June 12, 13,600; on June 24, 24,000; on June 29, 22,400. The urine showed a trace of albumin but other changes were unimportant. The laboratory report on the appendix showed only inconspicuous lesions. The pus from the abscess contained staphylococcus aureus.

Comment.—Diagnosed as acute appendicitis and appendix removed with no improvement in symptoms; seventeen days later a perinephric abscess was opened and patient promptly recovered; probable source of infection was pelvic; no material urinary phenomena.

Case XXVI. German Hospital.—A. G., male, aged 18, musician. Admitted November 18, 1906; discharged December 8, 1906. Three weeks before admission noticed pain in region of left kidney, at first intermittent but later constant. Does not micturate frequently. Has had chills and fever. Chest examination was negative; abdomen showed rigidity in left upper quadrant and posteriorly a swelling was noted below the costal margin and back of the posterior axillary line which fluctuated slightly. On November 19, 1906 a large abscess was opened and drained. It lay over the lower pole of the kidney and communicated with another smaller pocket toward the median line.

The urine showed a trace of albumin with some granular and hyaline casts. Leucocytes were 29,500. Temperature which was about 102 degrees, dropped at once to normal. No bacteriological report.

Comment.—No source of infection could be assigned.

Case XXVII. German Hospital.—T. K., male, aged 29, brewer. Admitted February 26, 1906; discharged March 31, 1906. Taken suddenly ill ten weeks before admission with acute pain at the right costal margin posteriorly. With this he had a chill and slight cough. Has had fever and has lost about 40 pounds. Five weeks ago had an attack of aphonia which lasted three days.

He was emaciated; lungs were normal, heart showed an aortic murmur; no distension of abdomen but slight rigidity was present. There was a fullness of the right lumbar region and he was very tender on palpation. By lumbar incision about a pint of pus was evacuated; no report bacteriologically. Temperature was irregularly between normal and 101 degrees for eight days, when it reached normal. Urine showed faint trace of albumin and casts occasionally. Leucocytes were 17,100 on admission, hæmoglobin 42 per cent.; a month later leucocytes were 9,700, hæmoglobin 54 per cent.

Comment.—Symptoms had existed ten weeks before operation with decided emaciation; no recognized source of infection.

Case XXVIII. Mt. Sinai Hospital.—J. T., male, aged 20, laborer.

Admitted November 21, 1908; discharged January 18, 1909. Illness began three weeks before admission with pain in his shoulders and right side of the back; no known cause; family and personal accounts were uninteresting. In the right loin from the last rib to the iliac crest there was a distinct mass which was very tender, painful, and it seemed to fluctuate. On November 23, 1908 a large quantity of pus was evacuated by lumbar incision. The abscess extended downward toward the pelvis, under the kidney, and toward the diaphragm. The urine at this time was practically normal. His temperature, which had ranged from 102 to 103, fell to normal in 24 hours. On December 3, 1908 his temperature suddenly shot up above 103 degrees, and in a day or two it was found that the left lung was entirely consolidated with pneumonia; there was also pleural effusion. He was extremely ill with pulse at times of 140 and respirations of 56. Recovery was slow, consolidation of the left base persisted for some time and it was fully three weeks before his temperature fell to normal. During this time he developed a purulent discharge from the right ear. The wound in his back healed slowly but without difficulty. His urine mainly showed febrile changes but no pus. Blood: Leucocytes 15, 360; polynuclears, 82 per cent. The pus contained staphylococcus aureus.

Comment.—This case is interesting in showing a pleuro-pneumonia of decided severity, involving the opposite lung from the abscess; urine normal and no source of infection recognized.

Case XXIX. University Hospital.—A. R. G., aged 27, native of Russia, salesman. Admitted May 17, 1909; discharged June 6, 1909. Chief complaints on admission were pain in back, cough with expectoration, vomiting and constipation. Six weeks ago had grippe which put him in bed one day; he then worked two weeks but had a cough so severe that he vomited. From the first he had pain in the right lumbar region extending forward and radiating down the inner side of the thigh to the knee; it is dull and aching except when he moves, when it is very sharp. The thigh was flexed and he was unable to straighten it without pain. Previous and family history unimportant; no venereal disease.

Abdomen was tender over the whole right side, becoming less at the middle line; an indefinite elastic mass was felt on deep palpation in the right hypochondrium; posteriorly some bulging was noted between the last rib and the iliac crest, and at this point there was acute tenderness with a feeling of fluctuation. The right abdomen measured 18 and the left 17 inches. There was some curvature of the spine with convexity toward the left; right thigh flexed to 45 degrees. Urine: Amber, normal odor, flocculent sediment, specific gravity 1030, acid, no albumin, no sugar, a few cylindroids and an excess of mucus. Hæmoglobin 82 per cent, leucocytes 16,900. Temperature ranged from 99 degrees to 100 degrees. Skiagraph was negative for stone or spinal caries.

On May 20, 1909 Dr. A. C. Wood evacuated a large perinephric abscess containing thick, greenish, and odorless pus. The cavity extended upward and inward for about 4 inches but there was no communication with the spine or kidney. On May 22 temperature, pulse and respiration were normal and the patient convalesced quickly and satisfactorily.

Comment.—It is probable that the so-called grippe attack was merely the pulmonary irritation associated with the abscess formation; urine unaffected.

Case XXX. Episcopal Hospital.—E. W., aged 19, female, spinner. Admitted September 8, 1908; discharged November 7, 1908. Five weeks prior to admission patient was caught in a door and sustained a severe contusion over the right kidney. She stated that she voided some blood and had some incontinence of urine. The pain from the contusion became less but she had some tenderness continuously. Two weeks ago the pain and tenderness became greater and she commenced to walk lame, as though the right leg was shorter than the left.

Examination: Great tenderness in the right flank, between the rib edges and the iliac crest; also considerable tenderness over McBurney's point on deep pressure. No limitation of motion or pain about the right hip joint. On September 26, 1908 she was operated on and a large perinephric abscess was opened. No notes on the kidney, but she made an uninterrupted recovery. The pus contained staphylococci. Blood: Reds, 5,290,000; whites, 27,680; hæmoglobin 63 per cent. Urine in five reports showed the average daily amount to be about 40 ounces. There was a trace of albumin but no pus; a few hyaline, pale epithelial and granular casts were observed. Fever was rather high but showed strong remissions (100 degrees to 103 degrees); it touched normal the day following operation but showed slight evening rise until September 30.

Comment.—A case apparently associated with trauma more directly than is usual; no evidence of renal source of infection.

Case XXXI. Jefferson Hospital.—K. J. B., aged 19, school boy. Admitted September 13, 1909. During the summer months he suffered from furunculosis, five boils having appeared on his left thigh. Two weeks before admission he was suddenly taken with intense, knife-like pains in the left loin which were referred to the hip and down the thigh. He soon became lame with stiffness of the left limb and extension was particularly painful. Has had fever of about 102 degrees; no bowel or urinary symptoms; has lost 15 pounds.

Pale, poorly nourished, though fairly developed lad; temperature 100 2/5, pulse 90, respirations 24; no tenderness or rigidity about the abdomen; right kidney not palpable; the lower pole of the left kidney was questionably palpable and there was tenderness anteriorly; on deep pressure under the ribs exquisite tenderness was elicited. There was a marked limp to the left leg and extension of the thigh was impossible. No œdema or redness anywhere. Examinations of the urine on September 13, 14, 16, and 18, gave normal results in all respects. Blood: Erythrocytes 4,200,000, leucocytes 24,000, hæmoglobin 69 per cent., color index .82, polynuclears 83 per cent. The X-ray showed an area of light shading about the left kidney, with poor definition of the organ.

On September 18, 1909, Dr. Schwartz evacuated about 6 ounces of thick yellow pus and found the kidney firm and of normal size. The pus gave pure cultures of staphylococci. The temperature was normal on September 21.

Comment.—A typical case having its source in furuncles of the corresponding thigh; normal urine.

Case XXXII. German Hospital.—L. O., aged 24, domestic. Admitted March 5, 1905; discharged April 12, 1905; re-admitted April 24, 1905; died June 17, 1905.

Healthy girl of good family and personal history. Eighteen months before admission she had an attack of sudden pain in right lumbar region which lasted about two weeks; six months later she had a more severe attack and for a year past she has had at irregular intervals pain which was aggravated by bending or stooping. Has lost about ten pounds in weight.

Examination showed floating right kidney, also a bulging above the crest of the ilium anterior to and just below the kidney area; it was resistant and doughy in feeling. At operation about a pint of pus was evacuated; the kidney was found to be loose and was apparently unaffected by the suppurative process. By the use of iodoform gauze it was replaced nearly in normal position. Urine showed a faint trace of albumin, leucocytes and phosphates. Temperature changes were slight, substantially not over 100 degrees. On discharge she had a granulating wound in the back, but was doing well; ten days later was taken ill with evidences of infection of some sort and was re-admitted on April 24, 1905. While nothing very definite showed about the lumbar area, she was again opened on April 29, 1905, and thoroughly explored. No disease of the kidney, spine or muscle was found. Her temperature remained septic but she was thought to have influenza; temperature was about 99 degrees in the morning, 102-103 in the evening. On May 27 an empyema was made out in the right chest posteriorly and a half pint of pus was evacuated. On June 3 another abscess in the pleura was opened nearer the spine. On June 12, 1905, it was noted that she had a left septic pneumonia and from this she died five days later.

Comment.—In this case the perinephrium of a movable kidney was affected but no disease of the kidney was shown; later the patient developed empyema of the same side and died of septic pneumonia of opposite side.

Case XXXIII. German Hospital.—H. G., 36, tobacconist. Admitted July 15, 1905; discharged August 16, 1905. Nothing in history of importance. Present illness began six weeks ago with pain in left side and back, which was sharp, shooting and continuous; no chills, no vomiting. Abdomen showed a mass in the left ileocostal space, extending anteriorly to nipple line, which seemed movable and caused pain on palpation. An oblique lumbar incision opened a large abscess filled with yellow, flaky pus. Four days later he developed a femoral phlebitis of the left leg. Fourteen examinations of the urine gave normal results. Leucocytes were 20,600; hæmoglobin 76 per cent. Slight fever (99-100) for the first ten days.

Comment.—A case complicated by femoral phlebitis; urinary changes absent and course practically afebrile.

CASE XXXIV. Children's Hospital.—B. C., aged 10. Admitted June 7, 1903; died June 21, 1903. Had measles, rubella, pertussis, and chicken-pox, but not scarlet fever, diphtheria or typhoid. Two weeks before admission was struck on right side of abdomen with blow of fist. The following day he vomited and had severe cutting pain just below right costal margin; the pain remained continuously but varying in severity. Has had no cough and no change in the urine or micturition. The right shoulder was lower than the left. Temperature for a week before admission average 103 degrees. Blood: Hæmoglobin 73 per cent., reds 4,700,000, whites 42,960.

On operation the following day the kidney was exposed and nothing found until a point in front of the upper pole of the kidney was reached, where a small abscess containing thick foul pus was opened and drained. On June 11, 1903, his temperature was normal and on June 14 he was sent to the country branch of the hospital. A few days later a second operation was necessitated apparently by reason of extension of infection. The old wound was re-opened without finding any collection of pus. However, sinuses were found running upward and inward and downward to iliac region. A counter opening in the iliac region opened the peritoneal cavity; the pelvis contained a large quantity of pus and was drained.

The child died on June 21, 1903. Autopsy showed all the cavities along the posterior abdominal wall to be bathed in pus and the pelvis was half full. Both the diaphragmatic and hepatic serosa were covered with fibrinous exudate and pus. The appendix was bound down in a greatly thickened mass of lymph surrounding the cæcum but when dissected out was found to be normal. The mass of lymph was tightly adherent to the posterior abdominal wall and in pushing this aside a pus cavity was found having the kidney for the floor. No notes on the kidney.

Comment.—An interesting case showing the effects of trauma. Death due to extension of inflammatory process to abdominal cavity, a condition liable to result from the anterior position of the original infection.

CASE XXXV. University Hospital.—A. McL., aged 16. Admitted May 31, 1909; discharged October 17, 1909. This boy had scarlet fever at the age of seven but otherwise was apparently healthy until present illness. It began seven weeks before admission with swelling under eyes and in the feet and legs, evidently due to nephritis. A month later he had a sharp pain in the left side, intermittent in character, which has continued. On the day before admission he noted a mass in the left iliac region which caused him to flex his left thigh; has had diarrhœa and vomiting since the onset of the pain in his side.

Physical examination showed many general signs of nephritis. Also tenderness in left loin posteriorly running down to left iliac fossa, where there is a distinct induration and mass. Urine: 1012, acid, cloud of albumin, no casts, many red and white blood corpuscles, triple phosphates. Blood: Reds, 3,130,000; whites, 48,800; hæmoglobin 48 per cent. On operation (June 2, 1909) by incision well above Poupart's ligament in the groin, about a pint of pus was evacuated. Counter openings were made posteriorly and abscess drained with rubber tubes. Pus was examined and found sterile. Temperature averaged 99 degrees to 100 degrees.

Later the evidences of nephritis continuing and ascites developing, he was again operated on (July 17, 1909) and a decapsulation of both kidneys done. The kidneys were large and white, with the left kidney slightly congested. On September 10, 1909, blood count was as follows: White, 14,600; reds, 3,530,000; hæmoglobin, 60 per cent. Abscess cavity healed uneventfully.

Comment.—In this interesting case the infection was of unknown origin; the leucocytosis was very high; there was pre-existing parenchymatous nephritis and a double decapsulation was done after the perinephric suppuration subsided.

CASE XXXVI. German Hospital.—U. R., female, 22. Admitted October 28, 1909, complaining of pain in right lumbar region which had existed for three weeks. It commenced as a dull ache and she found she could not fasten her corsets. It was characterized by pain in back and soreness over abdomen in front, no nausea, no jaundice, but she had a cough at first. Has had indigestion for several years.

Rather anæmic and poorly nourished girl. Abdomen distended and somewhat tympanitic. Slight rigidity throughout, but more marked about the upper right quadrant, where there is distinct tenderness extending back to lumbar region; most tender point is on a line from the ninth cartilage to the umbilicus. Liver not enlarged or tender. Mass felt where right kidney would be, which comes down with deep inspiration, but examination was masked by distention.

Under ether on October 30, 1909, abdomen was opened by right rectus incision and a slight amount of cloudy fluid was found in pelvis. Appendix slightly thickened but not acutely inflamed. Gall-bladder, stomach, and pelvic contents were normal. Abdomen closed and a loin incision exposed a kidney with a distended capsule which was opened and considerable pus escaped.

Blood: Leucocytes, 30,300; erythrocytes, 3,980,000; hæmoglobin, 68 per cent.; polynuclears, 88.5 per cent. Pus showed staphylococcus albus; pelvic fluid was sterile. Temperature range was 100 degrees to 101 degrees. Urine was normal prior to operation, but later showed some pus cells and epithelium.

Comment.—The diagnosis was difficult and the first incision was transperitoneal; the abscess was within the fibrous capsule which has not been noted before in this series.

TABULATED SYNOPSIS OF CASES COLLECTED.

	Sex	Age	Side	Source of infection	Complication	Postural change	Leucocytosis	Pus	Urine	Fever	Days ill	Days in hospital	Result
1	M	24	L	Unknown	Hard cough		16,600	Sterile	Tr. alb., no pus	Subnormal	25	123	R.
2	F	22	R	Probably pelvic	Cough, expectoration		44,550	No report	Tr. alb., few casts	Irregular, abt. 101°	60	42	R.
3	M	11	L	Source unknown	None		38,500	Staphylococci	Tr. alb., no casts	Irregular, abt. 101°	55	95	R.
4	M	23	L	History of trauma	Congestion, left lung		30,350	No report	Tr. alb., no pus	About 102°	21	62	R.
5	M	18	R	Necrosis of phalanx	None		18,200	Staphylococci	Normal	About 101°	14	20	R.
6	F	35	R	Possibly pelvic	Pleuropneumonia		28,000	Strept. pyogenes	Tr. alb., no casts	About 99°	180 (?)	11	D.
7	M	39	R	Unknown	None	Thigh flexed	15,200	No report	Normal	Bet. 101° & 102°	35	95	R.
8	M	49	R	Unknown	None	Curvature of spine	29,600	No report	Normal		23		
9	F	52	R	Unknown	Cystitis, pleurisy, congestion of right lung			No report	Normal	Bet. 100° & 102°	14	74	R.
10	M	39	L	Unknown	Cong. of left lung		16,800	Staph. & a bac.	Tr. alb., few casts	99°–100°	12	63	R.
11	M	25	R	Unknown	None		14,520	Colon bacillus	Normal	About 100°	30	33	R.
12	M	26	L	Unknown	None		34,600	Staph. albus	Normal	99°–100°	21	24	R.
13	M	40	L	Unknown	None		11,700	Colon bacillus	Tr. alb., no pus	Normal to 101	21	18	R.
14	F	50	R	Pyonephrosis, etc.	Chronic cystitis			No report	Alb. quan. pus, etc	Subnormal		29	D.
15	M	19	R	Mixed urethral infection	Prostatic abscess		16,200	Strept. pyogenes	Few gran. casts		90	112	R.
16	M	34	L	Unknown	None			S. aureus	Normal	Irreg. to 102	14	50	R.
17	M	59	R	Probably renal	Pul. congestion	Thigh flexed.	13,500	Strep. and pneumococci	Alb. pus, casts	101–102	21	24	D.
18	F	58	L	Pyonephrosis	Cystitis			No report	Alb. pus, casts		28	58	R.
19	M	60	R	Possibly influenza	Cough	Right-sided lameness		S. aureus and albus	Few casts, no pus		60	90	R.
20	F	45	R	Possibly pelvic	None	Thigh flexed	26,940	Colon bac.	Tr. alb., few casts	103	12	37	R.
21	M	28	L	Unknown	None	Both thighs flexed		Colon bac.	Normal	99–100	30	12	R.
22	M	21	R	Unknown	None		16,500	Colon bac.	Normal	About 102	4(?)	43	R.
23	M	32	R	Probably urethral	None			S. aureus	Tr. alb., few casts	Normal	30	29	R.
24	F	60	L	Probably pyonephrosis	None		23,300	Colon bac.	Tr. alb., casts, pus		30	33	R.
25	F	18	R	Unknown	None		24,000	S. aureus	Tr. alb., no casts	99–103	..	42	R.
26	M	18	L	Unknown	None		29,500	No report	Tr. alb., casts	About 102	21	20	R.
27	M	29	R	Unknown	Slight cough		17,100	No report	Tr. alb., occas. casts	99–101	70	35	R.
28	M	20	R	Unknown	Pneumonia; otitis		15,360	S. aureus	Normal	102–103	21	58	R.
29	M	27	R	Possibly influenza	Severe cough	Thigh flexed; spinal curvature	16,900	No report	Normal	99–100	42	20	R.

	Sex	Age	Side	Source of infection	Complication	Postural change	Leucocytosis	Pus	Urine	Fever	Days ill	Days in hospital	Result
30	F	19	R	Hist. of trauma......	None...............	Right-sided lameness	27,680	Staphylococci....	Alb. few casts....	100–103......	35	61	R.
31	M	19	L	Furunculosis, left hip.	None...............	Thigh flexed	24,000	Staphylococci....	Normal.........	About 100...	14	..	R.
32	F	24	R	Unknown...........	Empyema, septic pneumonia	....	......	No report.......	Tr. alb., no casts	99–103........	..	107	D.
33	M	36	L	Unknown...........	Femoral phlebitis....	....	20,600	No report.......	Normal.........	99–100........	42	32	R.
34	M	10	R	History of trauma ..	Suppurative peritonitis	....	42,960	No report.......	Normal.........	About 103....	14	14	D.
35	M	16	R	Unknown...........	None...............	Thigh flexed..	48,800	Sterile..........	Alb. casts, no pus	99–100........	30	..	R.
36	F	22	R	Unknown...........	Early cough.........	....	30,300	Staph. albus.....	Normal.........	100–101......	21	..	R.

NOTES

Case No.
1. Primary incision was transperitoneal.
6. Died 9 days after operation, of pneumonia.
7. Diagnosed as typhoid fever.
8. Had sciatic pain and resisted efforts to flex thigh. Declined operation.
9. Diagnosed as cholecystitis; opened abscess and drained through transperitoneal incision.
14. Autopsy showed pyonephrosis, nephrolithiasis, etc.
15. Probably later developed laryngeal tuberculosis.
16. Primary incision was transperitoneal.
17. Died from cardiac dilation due to myocarditis.
18. Two sinuses into pelvis of kidney were found at operation.
19. Obliterative pleurisy from 6th rib downward, right side.
24. An indurated mass in front of left kidney was not opened.
27. Diagnosed and operated on for appendicitis; seventeen days later a perinephric abscess was opened.
28. Severe pleuropneumonia on opposite side from the abscess.
32. Abscess involved the perinephrium of a floating kidney; later developed an empyema of right side and a septic pneumonia of left side, and died.
34. Secondary infection of abdominal cavity; autopsy showed extensive suppurative peritonitis.
35. Abscess occurred in the course of parenchymatous nephritis.
36. Suppuration was not in adipose capsule but beneath fibrous capsule; transperitoneal incision primarily.

ANALYTIC SUMMARY OF CASES COLLECTED.

Of the 36 cases submitted 25 were males and 11 were females. The age of the oldest patient was 60 and the youngest was 10, with a general average of 31 years, or omitting the cases of pre-existing renal infection, the average age was 28 years, showing clearly that the disease is one of early adult life. The right side was affected in 23 cases, the left in 13. The source of infection was unknown in 20 cases, in 2 there was pyonephrosis, 2 others were probably of renal origin, there was urethral infection in 2, influenza preceded 2, 3 were possibly derived from pelvic disease, peripheral suppurations probably caused 2, and trauma was prominent in 3 instances. Postural changes were noted in 10 cases, in the main being a tendency to flex the corresponding thigh, though in several cases there was some spinal curving and in one with sciatic pain flexion of the thigh was resented. Pulmonary phenomena were seen in 13 cases, varying in intensity from a simple cough to a fatal septic pneumonia; in 3 cases cystitis was present; 1 case developed subsequently a prostatic abscess; 1 had otitis media; 1 had femoral phlebitis; in 1 there was a fatal cardiac dilatation, due to myocarditis; and in 1 the perinephric suppuration occurred in the course of parenchymatous nephritis. The urine was normal in 15 cases, practically normal in 5, having a trace of albumin with casts, etc., in 12, and showing pus in 4. The bacteriological examination of the pus from the abscess was made in 23 cases and gave sterile results in 2 cases, colon bacillus in 6, staphylococci in 5, staphylococcus aureus in 4, staphylococcus albus in 2, staphylococcus aureus and albus in 1, streptococci in 2, and streptococci and pneumococci in 1. 35 abscesses were evacuated and 1 declined operation and was discharged; 30 cases recovered and 5 died. This gives a total mortality of 14.3 per cent., or omitting the cases of recognized renal origin, two of the four dying, there is a mortality of 9.7 per cent. The cause of death in the two renal cases was exhaustion in one and cardiac dilatation in the other, but both were probably uremic. In the other cases one died of pleuro-pneumonia, another of peritoneal extension of the suppurative process, and the third of septic pneumonia. The death rate is lower than in any previously reported series and compares most favorably with the 34 per cent. mortality of Küster's tables; this is doubtless due to the early recognition of the disease and the adequate drainage without unwise interference with the kidney.

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GENITAL CANAL BLOCK FOLLOWING NEISSER COCCUS INFECTION.*

BY CHARLES E. BARNETT, M.D.,

OF FORT WAYNE, IND.

It is suggested by Bumm[1] that the greatest rôle in gonorrhœal sterility is played by man instead of woman, on account of a block somewhere in the genital canal.

It will be the aim of this paper merely to show how the body of man is handicapped when the genital canal is blocked from a pathological condition due to infection.

The writer believes that race suicide, childless marriages and disrupted homes are important factors on account of gonorrhœic sterility in man, yet he believes that the pathology produced from a lack of drainage in this canal overshadows the other points in importance.

Deep urethral infection is necessary in order to produce this pathology, and while it is possible for the gonococcus to produce deep infection in other ways, the most used route is from the urethra to the sinus pocularis, flooding the prostatic ducts, through the sinus to the ejaculatory ducts into the vesicular ducts and vasa ampullæ and on up the vasa to the epididymi (Figs. 1 and 2).

When this upper tract is free from contamination a secondary infection may be produced when pressure is made upon an infected vesicle or vas ampulla with atresia present in front of the vesicular duct, whereby a short circuit will be formed and the infection will be reverted back up the vas to the epididymis.[2]

When occlusion occurs anywhere from the efferential vessels, through the epididymis to the deferential ducts, azoospermia would present. On the other hand, with this

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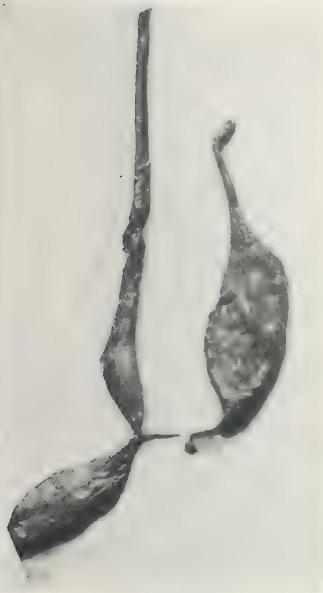
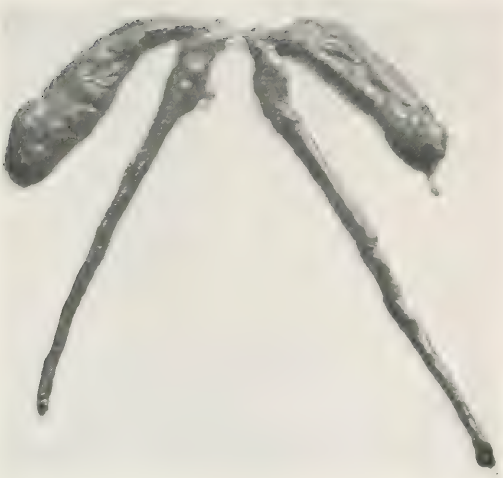
*Read before the Mississippi Valley Medical Association, Oct. 14, 1900.

FIG. 1.



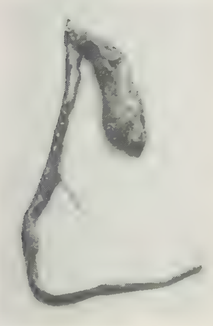
Shows a normal right vesicle and vas ampulla dissected loose from the perivesicular fascia down to the ejaculatory duct which you see emptying into the sinus pocularis (utriculus masculinus). This picture demonstrates the minuteness of the duct lumen. The left vesicle and vas are intact. Along the outer border of this vesicle you see some pathology.

FIG. 3.



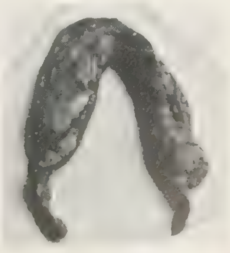
Shows both right and left vesiculæ along with the ampullæ of the vas, pathologic. All ducts are blocked. The destructive metamorphosis has obliterated the ejaculatory duct.

FIG. 2.



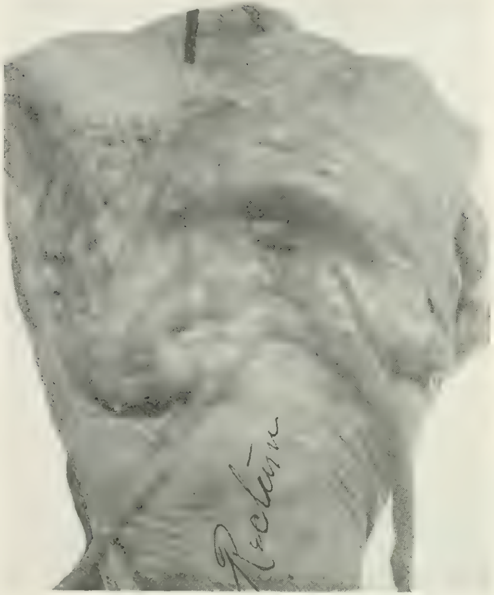
Shows an atrophic vesicle and vas deferens. The proximal end of the ejaculatory duct along with the ducts of the vesicle and vas ampulla are blocked while the distal end of the ejaculatory duct is patent.

FIG. 4.



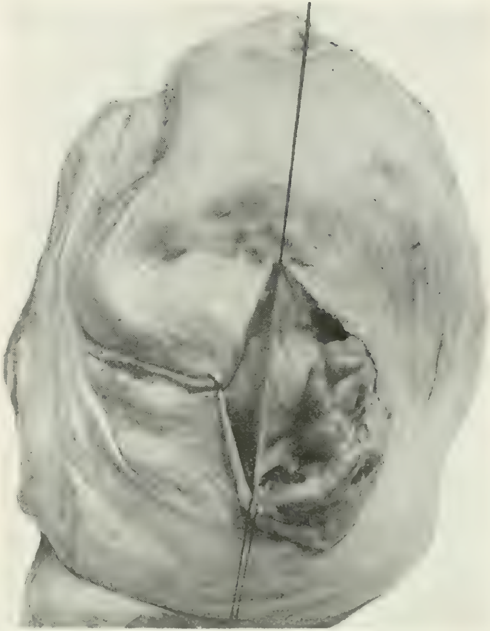
Shows a conglomerate mass whereby the seminal vesicles and vasa lose all lines of conformation.

Fig. 5.



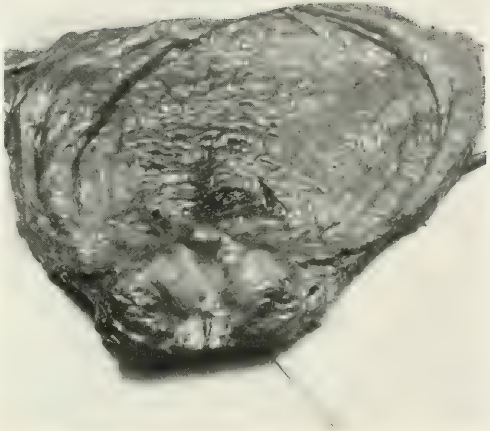
Shows retention cysts of the left seminal vesicle. The right looks more fibrous in character. The vas ampullæ are also cystic. (Subperitoneal dissection at vesicorectal fold.)

Fig. 6.



Shows a subperitoneal dissection where the right vesicle and vas are loosened from the vesicular fascial fold. The vesicle and vas ampullæ show clearly distention on account of the block in the ejaculatory duct below.

Fig. 7.



Shows a classic picture of bladder pathology. The point of interest is the atresia of the sinis pocularis. The silver probe shown in the picture is bent upon itself and is pushing down the fold of tissue that formed the occlusion to the ejaculatory ducts.

channel open, marked pathology might be present, blocking the vesicular and prostatic ducts but leaving the canal open for spermatozoa. The probable cause, though, is a blocking of the ejaculatory ducts on account of the minuteness of their lumen (Fig. 3).

It is needless to say that the "coupling up" of the vas deferens to the head of the epididymis in Martin's operation (epididymovasorraphy) will do no good unless the canal is patent throughout the rest of its course.

Vasostomy, vesiculotomy, epididotomy and the evacuation of a prostatic abscess are all operations, in the writer's opinion, to relieve pathology resulting from genital canal block.

Fortunately none of these interferences seem to influence testicular hormone (orchicism).

In my notes on a large number of bladder dissections I find it repeatedly stated that the ejaculatory ducts in the majority of the pathologic subjects, were found blocked. The following is an extract from my notes on the second case of atresia found in the sinus pocularis: "Inflammation into right vesicle; left vesicle partly inflamed. Vascular pole does not interfere with ureter of mainly affected side. A prostatic duct on left side very large; likely ruptured acinus. Left ejaculatory duct stenosed. Right normal. Utriculus masculinus non-patent."

In order to more perfectly illustrate this subject photographs were made while the writer was doing these bladder dissections last winter. The aim is to show the gross pathology in its differences, one to another, rather than repetitions of the same findings. Figure 7 contains the most points of interest, for in this photograph of atresia of the sinus pocularis you see a thoroughly pathologic picture showing the results of posturethral infection. The atresia was merely an accidental closing of the gap of entrance to the coccus that infected the prostate and vesiculæ by way of the ejaculatory ducts. Had the improbable occurred and the atresia been the whole product of the infection, aspermia and azoospermia would have been just as completely pronounced. It is interesting to know that in this case where the block was perfect, pus was found in both epididymi.

The great problem is how to remove the pathologic condition. It is the writer's opinion that when block occurs in the ejaculatory ducts, the vesicles and vasa ampullæ become retention cysts and frequently the prostate and vesicles become agglutinated, and the prostate when removed brings away the vesicular pathologic condition. A prostatectomy thus takes credit for relieving a case where the seminal vesicles were really at fault. It was the writer's privilege last winter to see Zuckerkandl remove a prostate upon which the vesicles were so fastened that a vesiculectomy had also to be done.

In the correction of this pathology the surgical hypothesis is a difficult one, when the final results anticipate normal function. It is true that in some cases the cysts are emptied and the block preventing drainage removed. This relieves the symptoms temporarily, but the time may finally come when a recurrence will happen, indicating that a thorough removal of the pathologic field is necessary in order to prevent a farther extension of the diseased process, rather than to try to save a crippled canal surrounded by contaminated glands that are always nagging the body with their symptoms of distention. The writer believes that the prophylaxis of educating the young boy against infection from the Neisser coccus will result in the most good. A pound of prevention will keep him from finally having to come to the surgeon for an ounce of cure.

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TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY.

Stated Meeting, held December 6, 1909.

DR. WILLIAM J. TAYLOR, the President, in the Chair.

OPERATION FOR WRY-NECK.

DR. JAMES K. YOUNG presented a boy, 11 years of age, upon whom he had operated, July 7, 1909, at the University Hospital, for torticollis of a severe type, due to injury in birth. There was a marked contraction of the sternocleido mastoid muscle with contraction of the platysma. An open operation was performed on account of the extensive amount of tissue involved in the contracted tissues. Two vertical straight incisions were used, one over the sternal and one over the clavicular portions instead of the transverse or flap method. The sternal and clavicular portions of both were divided by careful dissection. The deep jugular vein was exposed during the division of the clavicular portion. The deformity was corrected as fully as possible and fixed in plaster dressing for four weeks. Subsequently a special wry-neck dressing was applied.

SACRO-ILIAC DISPLACEMENT.

DR. YOUNG presented a man, aged 23 years, who entered the University Hospital, October 26, 1908. He had been injured in the sacrolumbar region two years before by being thrown upon a railroad track. He suffered from severe pains in the sacro-iliac region for two years and at the time of the first examination he had severe spasms of the rectospinal muscles; there was pain over the sacral region extending down toward the anus. An X-ray examination was negative for displacement, but the test which was applied indicated that there had been a displacement of the sacrum on both sides. A special spring fixation brace was designed and applied and he has been given the high frequency current by Dr. Pancoast in the X-ray department of the University Hospital. His improvement has been marked. The apparatus which he wears has some advantages over the spring appliance used by French surgeons and by Dr. Goldthwaite, in that it extends around the sides of the pelvis and holds the pad more securely in an even position; the pressure can be increased in the upper and lower parts by the lateral straps which are attached to a stockinette abdominal belt.

Dr. John B. Shober said that sacro-iliac displacement was a much more frequent condition than was commonly supposed. The fact that these cases are very often reduced spontaneously is one of the reasons they are not more frequently recognized. The cause is almost invariably traumatism and the diagnosis not difficult in recent cases if one is familiar with the possibility. He had seen but two cases of sacro-iliac displacement. In one patient reduction was accomplished easily, a few hours after the accident. The other case was one which ran a longer course. He had never had to deal with a double displacement. As a rule, after the reduction the lameness disappears in a week or ten days. While the displacement is present the lameness is very marked.

Dr. Young, replying to inquiry in regard to the diagnosis and reduction in difficult cases of sacro-iliac displacement, said that the diagnosis had been very carefully given by Goldthwaite. The test consists in placing the patient for the anterior test on the back with, say, the right limb fixed on the bed; then the left leg is lifted from the bed without flexing the knee. If it does not go as high, if the extension or flexion of the limb when the knee is extended is not equal to the other side, and if the pain is acute, we suspect an anterior displacement of the sacrum. The posterior test can also be made by extending the limb upward with the patient lying on the face. The reduction of these displacements is generally difficult. There is a method of reducing these displacements varying in every case. In those patients who periodically have the displacement reduced there is frequently associated curvature or some other condition. He recalled one such case with a lateral curvature of the spine which he was able to correct by complete reduction and proper bandaging.

The pain is very acute in all cases, and many cases formerly considered lumbago and sciatica are really instances of sacro-iliac displacement.

ACUTE POTT'S DISEASE.

Dr. Young presented a girl, aged 13 years, who was seen by him July 10, 1909, at the Polyclinic Hospital. She was then suffering from an acute inflammation of the cervical vertebræ. The history was that on April 7, 1909, she laid all night on a lounge with her head hanging over the end. In the morning it was found that the head was drawn to one side and she experienced great pain which increased greatly and was not improved by medical treatment, especially massage and electricity, and she was referred to Dr. Young by Dr. Victor Loeb. For the correction of the torticollis she was placed in bed for ten days with head extension. The pain at this time and preceding the first examination was of a most acute character and the patient was prostrated. The X-ray revealed an inflammatory lesion of the third cervical vertebra. A special extension head brace designed by the reporter was applied, and subsequently she was sent to the seashore. The deformity has disappeared and her recovery is now complete.

PERINEPHRIC ABSCESS.

Dr. Morris Booth Miller read a paper with this title, for which see page 382.

Dr. John B. Deaver said that in the etiology of perinephric abscesses traumatism without question plays a part. There are, of course, a certain percentage of these cases which are hæmatogenous and a certain number which are tubercular. In one of his cases, in which Dr. Miller had witnessed the operation, he could not differentiate the condition between a high appendiceal and a kidney condition. There were no symptoms referable to the kidney either in the shape of subjective symptoms, or from X-ray, or cystoscopic examination, ureteral catheterization, or chemical examination of the urine. She had circumscribed tenderness anteriorly but not posteriorly. He opened her abdomen believing it to be a tubercular case with abscess, and that if he did not succeed in reaching the abscess cavity that he could at least locate it. When the incision was made serous exudate immediately escaped; there were enlarged mesenteric glands and exudate around the duodenum and hepatic flexure of the colon;

the post-peritoneum was densely infiltrated and adherent at the latter point,—all these conditions pointing to the kidney. The incision was closed and a posterior one made; the perinephric fat and capsule were normal, but an abscess upon the anterior surface of the kidney beneath the true capsule was found. He firmly believed the case to have been tubercular, although no tubercular reaction was obtained on administration of tuberculin, and the patient made an uninterrupted recovery. In a more recent case of localized abscess of the upper pole of the left kidney in which the colon bacillus was found, he questioned if it was not also tubercular and the presence of the colon bacillus due to a mixed infection. More frequent than perinephric collections are collections within the kidney. His experience with this condition tallies with Dr. Miller's conclusions, that in perinephric conditions where the kidney is healthy practically all get well.

Dr. John B. Roberts said that Dr. Miller's paper gave some light as to diagnosis by speaking of the kidney triangle where pressure located at this point, earlier than other symptoms, may lead to a diagnosis of perinephric lesion. If he is correct in thinking that pus around the kidney gives a higher leucocyte count than similar abdominal lesions, this should be a very valuable aid in diagnosis. He is right in saying that a good many cases of perinephric abscess are primary and not secondary to the kidney lesion. He recalled two cases seen some years ago, one a case of perinephric abscess the result of an internal urethrotomy for an old stricture, and in the other case a perinephric abscess the result of a gonorrhœa causing general sepsis, there being abscesses in other parts of the body also.

Dr. John H. Gibbon said, in reference to perinephric abscess not having its origin in the kidney, he thought many conditions were called perinephric abscesses which were not. Many are tuberculous, having their origin in the muscle sheaths. Surgeons are apt to call an abscess opened posteriorly a perinephric abscess. Those which are truly tuberculous, he thought, keep up discharging for months and months, many afterwards developing some change in the lumbar spine, showing an origin in Pott's disease. Tuberculous muscular abscesses are often called perinephric; they are not perinephric, they are in the abdominal wall and the surgeon has not gone through the muscular wall before he has opened the abscess. This explains the absence of any symptoms relative to the kidney in many so-called perinephric abscesses.

Dr. Morris Booth Miller (in closing), in answer to the suggestion that some of the cases reported were tuberculous, said that he had attempted to exclude all doubtful cases. The bacteriological examinations show no tubercle bacilli but the ordinary pyogenic micro-organisms were present in all the cases noted save two, where it was stated that the pus was sterile.

Dr. Roberts did not mention that 26 years ago he read before this Academy a masterly paper on the subject of perinephric abscess with particular relation to the referred pain, based upon careful anatomical studies. This work, which was published in the *American Journal of the Medical Sciences,* April, 1883, stands to-day as an authority upon this phase of the subject and as such has been frequently quoted.

The case mentioned by Dr. Deaver was an unusual one. In it the pus was entirely confined beneath the fibrous capsule and none was found in the adipose capsule. It was a staphylococcus albus infection. It was a difficult case to diagnose as the symptoms were vague though pointing to some upper abdominal trouble on the right side. Fever was moderate and the urine was normal. However, the leucocytosis was as high as 30,000 and there was a history of cough early in the attack.

He called attention to the apparent greater frequency of this disease in this country in contrast to European statistics. Socin found 4 cases out of 16,661 and Sutter noted 1 in 4437 cases. At the Presbyterian Hospital he had found 5 cases out of a total of 10,429, and at the German Hospital—where about 3500 cases are treated a year—the average number of perinephric abscesses is 2.

PUS IN THE ABDOMINAL CAVITY.

Dr. John B. Deaver read a paper with this title, for which see the April issue of the Annals of Surgery.

Dr. Walter G. Elmer inquired as to the value of abdominal irrigation especially in connection with stab wounds or gun-shot wounds of the abdomen in which the intestines have been completely severed. In such cases the surgeon has to deal with a very low grade of infection—the colon bacillus—which in its normal state is not virulent.

In regard to operating for appendiceal abscess and not removing the appendix he related the case of a trained nurse who undoubtedly had an appendiceal abscess but persistently objected to operation on the plea that her appendix had been removed. When, after much persuasion, the abscess cavity was opened the appendix was found inflamed and gangrenous, although the patient had been under the impression that it had previously been removed. He thought it would therefore always be better to tell patients when after such operations the appendix is left undisturbed, in order to prepare them if necessary for future developments.

Dr. John B. Deaver remarked, relative to the question of subdiaphragmatic abscess, that he had seen a large number of such cases. He had never seen a case of subdiaphragmatic abscess without some effusion in the pleura of corresponding side. The best way is to early resect the ninth rib; do not wait until the case is far advanced.

In the 70 cases of peritonitis he reported a bacteriological examination was made and a pyogenic organism found. Many were sick more than 40 hours. He maintained that if every case of peritonitis in the lower abdomen, particularly of the appendix, the gall-bladder and the pelvis, was operated upon within 40 hours of its onset, the mortality would be very small, probably 1 per cent. When the peritonitis has lasted for 50 hours the mortality begins to crawl up.

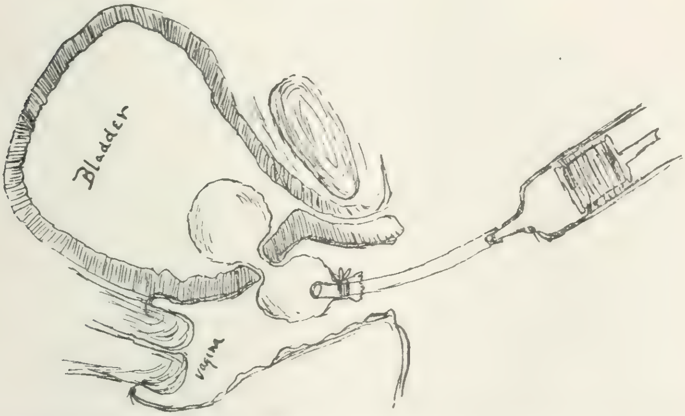
He had learned that a circumscribed appendiceal abscess where the appendix is not accessible is better treated without the removal of the appendix. There was a time when he did what Murphy had recommended, open the peritoneum, pack with gauze above the abscess and take out the appendix. He did this before Murphy recommended it and stopped doing it long before. In the majority of cases, say 45 out of 50, one will be able to remove the appendix, but there will be one case every now and then where the appendix had better not be removed.

As to drainage in stab wounds of the peritoneum, he had operated upon very few such cases. He had one case not long since of rupture of the intestines where suture was required. He no longer washed such cases out, but wiped them. He was not as much afraid of fæces in the peritoneal cavity as he was of pus. He was not afraid of the colon bacillus in the peritoneal cavity unless associated with pus.

PLUGGING A VESICOVAGINAL FISTULA.

Dr. George Erety Shoemaker reported the history of a woman in whom a large tumor of the kidney was bleeding so freely as to choke the bladder. It was decided not to attempt removal of the offensive decomposing clots with an evacuator, with the probable necessity of repeating the operation as hemorrhage continued. The hæmoglobin was already 25 per cent. and infection of the kidney imminent. A vaginal opening was therefore made into the bladder and the clots removed, after which frequent irrigation easily made the field clean. It was now necessary to prove the sufficiency of the opposite kidney. Any one who has tried to cystoscope the collapsed bladder with a fistula in it will appreciate the problem. The following procedure was adopted with entire success.

Fig. 1.



Temporary closure of vesicovaginal fistula by distended rubber finger-cot, for cystoscopy.

With the assistance of Dr. Laws the end of a piece of rubber tubing was lashed tightly into the open end of a thin rubber finger-cot. The collapsed rubber bag thus made was pushed part way through the fistula so that one-half was in the bladder, the other half in the vagina. On distending the rubber bag with water the two ends dilated while an isthmus formed at the site of the fistula, holding the appliance in place. The valve-like action made a tight closure. Water was now injected into the woman's bladder and the cystoscope used as usual. By watching the spouting of blued urine from the two ureters it was determined that one kidney was doing nearly all the work. Nephrectomy was successfuly done. The fistula was afterward closed under local anæsthesia, using eucaine and adrenalin.

It was found experimentally that it was not difficult to keep this patient dry with this apparatus for some hours by clamping the tube. However, when her bladder contracted after normal urination there was a tendency to drive the fluid out of the inner sac and thus displace the appliance. Of course a longer and larger bag can be used for a larger fistula.

SUBPHRENIC ABSCESS FOLLOWING APPENDICITIS.

Dr. John H. Jopson reported three cases of subphrenic abscess secondary to appendicitis, as follows:

Case I.—M. M., male, aged 40, was operated upon at the Presbyterian Hospital in August, 1906, for an acute gangrenous appendicitis and diffuse peritonitis. Removal of the appendix, drainage, Fowler position, enteroclysis. The abdominal symptoms were promptly relieved. The temperature, however, continued elevated between 100–102°, without marked increase in pulse or respiration, while the general condition was excellent.

Failing to find evidences of accumulation in the lower abdomen, and flatness being present over the lower lobe of the right lung, posteriorly, puncture of the pleura was practised on the seventeenth day, with negative results. Dulness persisted, but characteristic physical signs were absent. Patient's condition continued good and diagnosis by exclusion pointed to subphrenic collection, which diagnosis was confirmed by Dr. W. E. Hughes four weeks after operation. On the following day, before operation could be performed, the abscess discharged through a bronchus, much pus was expectorated, and the patient experienced characteristic shock with high fever, accelerated pulse and anxious expression. Aspiration in the ninth inner space gave pus from beneath the diaphragm, and operation under local anæsthesia, twelve hours later, showed the pleural cavity the sight of much recent effusion, and a subphrenic abscess, which was drained by transpleural route. Recovery followed.

No pleural or pulmonary infection or irritation were present until rupture occurred, and the prolonged elevation of temperature and the modest physical signs at the base of the right lung were the only danger signals present before rupture and pulmonary shock developed.

Case II.—Catherine T., aged 8, white, was operated upon at the Presbyterian Hospital, September 9, 1909, for acute appendicitis of two days' duration. The appendix lay well above the crest of the ilium, in the posterior position. It was perforated, gangrenous, lay in a moderate sized abscess, and was removed. Counter opening made in the loin, drainage by tube and gauze instituted. Pleural friction rub developed on the right side the following day, and twelve hours later there were fine râles over the same area posteriorly.

For three days the temperature continued elevated, pulse rapid and irregular (140–160), respirations from 40–48, and she was delirious. There were râles and harsh breathing over the right base posteriorly. Her condition then improved somewhat, but the temperature remained at about 100, pulse and respiration still rapid. There was dulness as high as the scapula on the right side, fine râles, and a loose cough. A small fecal fistula was observed in the posterior wound; otherwise the abdominal condition was satisfactory. The diagnosis was bronchopneumonia. On the fourteenth day her condition was noted as not so good. She had lost much flesh, took her nourishment poorly, temperature ranged from 99–101, physical signs in the chest remained the same, diarrhœa was present. Tuberculosis was suggested by a medical colleague. On the eighteenth day the subphrenic space was aspirated, in the ninth inner space posteriorly, and foul, thick pus was evacuated. Operation refused, but consented to on the following day.

Operation was performed on the nineteenth day after primary operation. Posterior transpleural drainage by resection of ninth rib behind postaxillary line. Pleural cavity contained no effusion, but wall was gray and œdematous. Suture of parietal and visceral layers of pleura, and further protection of pleural cavity by packing. Large abscess found beneath the diaphragm extending as far toward the median line as the vertebral column. Operation well borne. Death from exhaustion the following day.

In this case there were symptoms of pleural inflammation, and later of consolidation in the right lung. Moderate, persistent elevation of temperature, rapid pulse and respiration, and later rapid emaciation.

Counter opening at the first operation was made by reason of the high location of the appendix, with the deliberate intention of avoiding a subphrenic infection. This it failed to do, or, more probably, such infection was already present. The symptoms closely simulated those of septic pneumonia. The prolongation of the process and the rapid emaciation indicated the subphrenic location of the infection. Had aspiration been practised earlier, it is possible that recovery might have resulted. No postmortem was obtained and we cannot say, therefore, whether a pneumonia had been present or whether the symptoms were only those of subphrenic abscess and secondary pleurisy.

Case III.—Mrs. Ada V., aged 25, was operated upon at the Presbyterian Hospital, June 29, 1909, for acute appendicitis of three days' duration. The appendix was perforated and gangrenous, pointed upward beneath the liver, almost touching it, and extending deeply into the right subcostal region. There was an abscess at this point, a large collection of pus in the pelvis and free pus all through the right side of the abdomen. Tube and gauze drainage from right subhepatic space to pelvis. Murphy-Fowler after treatment. Right-sided pleurisy developed promptly after operation with slight increased dulness over lower chest posteriorly. Temperature remained elevated with brief remissions, ranging from 100–102. There was profuse purulent discharge from the wound; pus was washed out in large quantities, especially from the upper tube. Secondary posterior drainage was considered, but gradual diminution of discharge, occasional remissions of the temperature, and the fact that the general condition remained fairly good decided against it. The temperature fell to normal after three weeks, but rose again, and on July 31 patient expectorated small amounts of pus of decided odor. There was flatness to the ninth rib posteriorly and forward to the postaxillary line. No alteration of area of dulness on change of position, diminished fremitus over the area. Discharge of pus was much diminished. There was evidently a subphrenic collection, and operation was deferred for a day or two on account of moderate shock. There was rapid improvement, however, and the abscess finally drained itself; small amounts of pus being expectorated, the greater portion being washed out through the tubes. Aspiration of the pleura on one occasion gave only serum.

The patient made a tedious recovery, with final complete return to robust health.

A study of this case shows that following appendiceal perforation and abscess in the subhepatic region there were prompt development of pleural inflammation, as shown by the usual symptoms: friction rub, pain, etc., a prolonged period of moderate fever, the development of a subphrenic collection which was evacuated partly through the lung, but mainly through the drainage tract. Aside from some loss of flesh, constitutional depression was mainly conspicuous by its absence, except on two or three occasions when shock and pulmonary irritation were marked, notably when pus was evacuated through the bronchi.

Some criticism might justly be made, because secondary drainage of the subphrenic space was not instituted. Temporary improvement, however, occurring on each occasion when operation had been decided upon, resulted in postponement, and the patient was finally fortunate enough to escape without a transpleural thoracotomy, which while a comparatively simple and easy operation in itself, is attended by certain manifest risks. Nor could this case fairly be classified as recovery of an unoperated case. Drainage vicarious but finally successful through the long tract between the abdominal wound, the posthepatic and subphrenic regions was present from the first, and comparatively a small amount of pus perforated the diaphragm and bronchus and was expectorated.

Dr. Jopson remarked further that subphrenic abscess is a rather infrequent complication of appendicitis. Elsberg collected 73 cases and Eisendrath added 33, a total of 106 cases reported up to 1908. Weber noted it in 9 cases out of 350 cases of appendicitis, and Moschowitz found it 8 times in 2000 cases in the Mt. Sinai Hospital. Appendicitis ranks according to most authors after gastric and duodenal ulcer, as the most frequent cause of subphrenic abscess, one-third of the cases being due to perforated ulcers around the pylorus, and one-sixth to appendicitis. Of the seven cases of subphrenic abscess which he had seen, in three it followed peritonitis from perforation of the appendix. The splendid paper by Barnard in the *British Med. Journal* in 1908, was a noteworthy contribution to the anatomy of these and other types of subphrenic abscess. The majority of subphrenic abscesses from appendicitis are intraperitoneal, the pus finding its way upward behind the cæcum and colon, and the position of the appendix has much to do with favoring such a course. The posterior position of the appendix, and especially a high location, places the abscess in the most favorable site for invasion around the liver to the subphrenic space. An extraperitoneal collection on the right side may form between the layers of the coronary ligament, which it separates, being continuous with the retroperitoneal tissue below, as Barnard emphasizes; an appendiceal collection which takes an upward course may reach it and become subphrenic without perforating into the peritoneal cavity. In the early stages, in cases of intraperitoneal infection, the process is diffuse, later the collection is walled off, forming a localized abscess. Hence, the advantage of postponing operation by the transpleural method in the early stages. The abscess at this time is small in size, deeply situated under the dome of the diaphragm and consequently difficult of access by this route. In the early stages the lumbar route is to be preferred. Occasionally the abscess will point in the epigastrium, and is conveniently opened there. In the majority of cases of any standing the abscess grows in size, pushes the lung up, the costophrenic sinus of the pleura is obliterated and posterior thoracotomy with drainage through or below the pleura is to be preferred.

Posture is an important factor in the development of subphrenic infections. Lymphatic drainage in the abdomen is upward through the diaphragm. In addition to this the subphrenic space is a natural anatomical pocket when the patient is in a recumbent position; hence, the influence of gravity in spreading infection to this neighborhood, and hence, also the advantage of the Fowler position in overcoming it. Unfortunately, infection has oftentimes reached this point before the case comes to the operating table, especially when the appendix is in the position already described.

As is well known the *symptoms* of such collections may be acute or chronic. In the very acute cases the temperature is often markedly elevated, the pulse may be very rapid, and severe pain, nausea, vomiting, with chills and sweats and the acute constitutional symptoms of sepsis may be conspicuous features. The points he would emphasize, however, are, that a moderate continuous elevation of the temperature, a pulse little if any above the normal, an entire absence of abdominal symptoms, and a physical expression of comparative comfort and well-being are to be recognized as not inconsistent with the presence of a subphrenic abscess. Owing to adhesions of the liver to the diaphragm the liver is not often displaced downward, at least anteriorly. Most of the physical signs are to be looked for in the chest, except in those cases where the abscess bulges forward in the right hypochondrium, forming a swelling in that region which occurs when the subhepatic space is involved. Otherwise, compression and inflammation of the lung, due to an upward projection of the abscess, are produced.

In regard to the *diagnosis* of subphrenic abscess from pleural effusions and pulmonary consolidations, it has been his experience that reliance on text-book descriptions, and the attempt to elicit the finer shades of distinction as to the exact shape and definition of areas of dulness, may be fallacious and lead to error, even on the part of the most skilful clinicians. It is not to be wondered at, therefore, that one's faith in physical signs is sometimes shaken.

Dulness over the base of the right lung posteriorly is a valuable sign. If it occurs in connection with diminished tactile fremitus, and a continuous elevation of the temperature, without adequate explanations in the abdomen, following an appendiceal operation, one may suspect that a subphrenic collection is present. The most frequent association of physical signs in these cases is said to be dulness with limitation or absence of breath sounds, vocal resonance and tactile vocal fremitus. The area of dulness is convex upward, unless gas be present. In the latter case tympany overlies dulness, and amphoric and coin sounds are presumably present. Immobilization of the thorax on the same side is sometimes noted, with cough and expectoration. Of course, the expectoration of pus is confirmative, but it is much to be desired that the diagnosis be made before this stage is reached; not only because sepsis may be much advanced, but because, as it has been his experience to see several times, the rupture of pus into a bronchus either from empyema or subphrenic abscess is attended by a degree of shock which makes operation at that time highly unfavorable.

Barnard did not find either friction sounds or râles present with any great frequency in his series, but the occurrence in two cases under Jopson's observation, of pleurisy and evidences of pulmonary involvement almost immediately after operation, and both in cases where infection was present in the subhepatic region from the time of rupture of the appendix, makes him inclined to believe that these symptoms are of some diagnostic value.

In cases of doubtful diagnosis the use of the exploring needle is of paramount importance; and its use at an earlier time than usually practised would undoubtedly result in saving a larger percentage of cases. If pus is found on aspiration of the subphrenic region below the ninth rib, operation must be at once proceeded with, as leakage and infection of the pleura through the needle puncture will almost certainly ensue if the costophrenic sinus has not been obliterated by inflammation. This occurred in Case I. Fortunately such obliteration often takes place early, and the drainage of the abscess can then be accomplished without risk of infection of the general pleural cavity. In a case of subphrenic abscess in a child reported some years ago by Dr. Jopson, the abscess had pointed through the diaphragm, both layers of the pleura and the chest wall, forming a collection outside the lateral wall of the thorax without infection of the general pleural cavity.

With few exceptions posterior thoracotomy is the route to be chosen in draining these abscesses. Many cases can only be reached by a transpleural operation, and if care be used in suturing the visceral pleura and the diaphragm to the intercostal muscles and further protecting the pleura by gauze before going through the diaphragm, serious infection of the pleura will usually be avoided. In this connection the subpleural methods of Elsberg and Eisendrath may be mentioned. The operation itself is a simple and easy one. It is the condition for which operation is done that makes the prognosis so serious and which furnishes the 25 per cent. mortality. High as this mortality is, it is lower than that of subphrenic abscess in general, which is estimated at from 35 to 42 per cent. in operated cases.

It is interesting to note that in children the mortality from subphrenic abscess is less than it is in adults. In 1903 Jopson collected 23 cases in patients under fifteen years of age. The mortality in 15 cases in whom operation was performed was 13.3 per cent. The explanation of this is probably to be found in the fact that appendicitis is the most frequent cause of subphrenic abscess in children, in whom perforation of gastric and duodenal ulcers with their excessive mortality is rare. In seven cases of this series, appendicitis was the cause of the infection. Most of the other causes active in adult life were present occasionally.

BOOK REVIEWS.

General Surgery. By Erich Lexer, M.D., Professor of Surgery, University of Koenigsberg. American edition, edited by Arthur Dean Bevan, M.D., Professor and Head of the Department of Surgery, Rush Medical College, University of Chicago. Authorized translation of second edition by Dean Lewis, M.D., Assistant Professor of Surgery, Rush Medical College. 4to, pp. 1200, 449 illustrations, 2 colored plates. D. Appleton & Co., New York and London, 1908.

It is a difficult undertaking to render in one volume, at the present day, a thorough account of the fundamental elements of surgery, yet this has been accomplished in this book. Stripped of all controversial matter, freed from antiquated methods and views, embodying all the accepted advances of recent times, rendered into good English, this Lexer–Bevan's "General Surgery" is a most valuable addition to the legion of text-books on surgery. The narrative is very direct, the history of surgical events very tersely and impartially dealt with, and an extensive bibliography is affixed to each chapter. The bibliography is partial to the German literature, but in all other respects the pen of the editor has been busy weaving into this narrative the fabric of American surgical effort. So numerous are the parentheses that this version, in English, must be conceded by the fastidious to be practically an American surgery.

The teachings of Lexer herein embodied we can trace to the inspiration of a master surgeon, E. von Bergman, at whose clinic he was active for many years and whence emanated many original contributions embodied in this work. Early in these pages we encounter the use of the original and telling expression "infection atria," meaning other than and more than a *"locus minoris resistentiæ."* This happy expression, once the subject of Lexer's special research, is followed by a lucid explanation of inflammation of blood-vessels, which in turn gives place to a sound exposition of the pathology of osteomyelitis based on the X-ray studies of Lexer on injected specimens of normal bones, supplemented by his original bacteriological research in this disease.

The chapters on Asepsis are those originally formulated by Schimmelbusch, also emanating from Von Bergman's clinic, and for this reason it is most surprising to find allusion to the needs of frequent washings with antiseptic solutions, so directly contrary to the concepts of asepsis.

The diagnostic aids available from bacterial hæmatology are briefly touched upon, and the value of positive culture emphasized and the negative findings not underrated. Notable here is the cognizance taken of the work of American collaborators. The leucocyte count is only valued when correllated with other symptoms; and cryoscopy is spoken of, in much the same tone, as no final arbiter.

Such rarer surgical infections as hydrophobia, tetanus, diphtheria, anthrax, glanders, and actinomycosis are amply considered. The entire article on blastomycosis, so elaborately rendered out of all proportion to its significance and its occurrence, is masterfully written by Dr. Oliver Ormsby. In contrast the more widely met and encountered leprosy is well done in fewer pages. Tuberculosis and syphilis are detailed with great thoroughness, and the *Spirochæta pallida* assigned as the "casus morbi" of syphilis.

The treatment of infected wounds is built on the implicit belief and faith in asepsis; hence the exclusive use of sterilized gauze and immobilizing dressing as the chief factors to combat infections. It is somewhat consoling to see the author include himself amongst those who would isolate all cases of erysipelas from general surgical wards.

Necrosis is used generically to cover all forms of death in its molecular form, as well as that of tissues as a whole, and the mechanical, chemical, thermal, and organic changes of the blood-vessels responsible for this are considered seriatim and supplemented by the rôle played by syphilis, diabetes, and arteriosclerosis.

Under Neuropathic Gangrene are grouped Raynaud's disease, paralytic decubitus, ergot gangrene, mal perforans.

In one hundred pages of Part V, the "varia" of surgery are mentioned chiefly: Congenital anomalies, œdemas, constitutional diseases of joints, bones, and tendons. In this chapter, we meet with aneurisms, and herein the endo-aneurismorrhaphy of Dr. Matas is well rendered.

The remaining 250 pages, nearly one-quarter of the book, are devoted to a succinct description of tumors, brought home to the mind and the eye still further by well-executed photographs showing topographical features and their gross, as well as microscopical, histological appearance.

Two brief chapters, styled Appendices, take in respectively Opsonins and Blood Transfusion. The former is from the pen of Dr. Rosenow, and the latter is abstracted from Dr. George Crile's articles.

MARTIN W. WARE.

A MANUAL OF OPERATIVE SURGERY. By Sir FREDERICK TREVES, Bart., and JONATHAN HUTCHINSON, JR. Third edition. In two volumes. Vol. I. Philadelphia and New York: Lea and Febiger, 1909.

Frederick Treves is the author of "Applied Anatomy," a "Handbook of Surgical Operations," a "Manual of Operative Surgery," and the editor of the three volumes constituting the "Manual of Surgery." The first edition of the "Manual of Operative Surgery" appeared in 1891. Since that time, the author has retired from active work to the enjoyment of honors which have been so abundantly bestowed upon him, and to the leisure for contemplation of the large amount of work and experience with which his hands have had to do. It is natural, therefore, that this third edition should represent more of the work of Hutchinson than it does of Treves. And so we find it. The junior author has added, eliminated, revised and rewritten until it is really a new book, resembling the former editions chiefly in that it bears the name of Frederick Treves.

As the two former editions were practical and well abreast of the best surgical thought, so is this. It is rather full for a manual and well worthy of being called a text-book on operative surgery. By omitting long descriptions of operative steps, details as to incisions, instruments, and so forth, much space is economized. We heartily approve of the author's statement that, "Both surgery and medicine have been greatly hampered in the past by the needless introduction of names." For this reason, the particular incisions of various surgeons are not given.

This first volume is divided into two parts. The first part deals with the general principles of surgical operations—the patient, the operator, the operating theatre and its fittings, instruments and accessories, the technic of operative surgery, and the after treatment of the wound. All of these things are described briefly, and bring out in a practical manner the essentials of treatment.

The author pays his respects to the operating surgeon in words so well chosen and descriptive that a sentence or two may be given: "A well-matured and well-balanced judgment guides the hand of him who shows most skill; he may do well who is bold, but he will do better who has precise knowledge. The surest sense of confidence rests with the operator who knows accurately what he intends to do, and how to do it. The least success follows the hand of the man who retains throughout the operation a speculative spirit, who depends largely upon his imagination for conditions, and upon the fortune of events for results. A shakiness of the hand may be some bar to the success of an operation, but he of a shaky mind is hopeless. In the handling of a sharp instrument in connection with the human body a confusion of the intellect is worse than chorea."

The descriptions of the abdominal operations are modern and sufficiently complete for practical purposes. The transduodenal route is advised for operations for stone in the ampulla of the common duct. Of pylorectomy the author says, "the operation lasts two hours or longer." This is perhaps longer than is required by the average dextrous surgeon. It should be borne in mind that shortening the time of the operation has been one of the chief factors in reducing the mortality of the operation during the last ten years. As to the choice of operations for cancer of the pylorus, gastrojejunostomy or excision, the latter is favored. Of pyloroplasty the author says, "The very elaborate plastic operation on the pylorus devised by Finney, an American surgeon, appears to us hardly to require description here." In the description of the operation for gastric hemorrhage, the most important step, placing a hand behind the stomach and pressing its posterior wall forward into the wound, is not sufficiently brought out. The description of operations upon the pancreas show practical experience with this organ.

Complicated intestinal sutures are not described. The double row of sutures, without artificial aid, is recommended. The treatment of intestinal obstruction is described both from the standpoint of the nature of the disease and the general condition of the patient, and with reference to the technic of the operative procedure. The operation advised for intussusception is Baker's excision of the intussusception through a longitudinal incision in the intussuscipiens. The descriptions of operations for hernia are clear.

Three rules for operating upon appendicitis are emphasized: "Every case of fulminating appendicitis should be operated on promptly." "During the first twenty-four hours or so after the onset of an acute attack of appendicitis immediate operation is advisable." "During an attack of appendicitis, if the local and general symptoms point to the presence of an abscess, this should be opened and drained." These are the rules which are pretty generally followed by surgeons the world over; but the general practitioner, who sees most of the cases of appendicitis, witnesses the spontaneous cure of more than a half of them, so that the second rule is applied by the surgeon in a minority of cases. It is this fact, however, that brings to the surgeon the necessity for the application of the two other rules.

The so-called Talma operation for cirrhosis of the liver is ascribed to Rutherford Morison.

Having finished with abdominal operations, operations upon the pelvis are next taken up. Following this are operations on the kidneys and other genito-urinary organs. We do not see that pictures of renal calculi, of ruptured kidney, or of papilloma of the bladder are an essential part of a manual of operative surgery. There are many other illustrations in this book which would be in place in a book on surgical pathology, diagnosis or general surgery, but which are distinctly out of place in such a work as this. The book would be improved by the addition of a few more illustrations of the technic of surgical operations.

The text of this work is admirable. It is not only scientific but it is interesting.

JAMES P. WARBASSE.

SURGICAL DISEASES OF CHILDREN. A Modern Treatise on Pediatric Surgery. By SAMUEL W. KELLEY, M.D., Professor of Diseases of Children, Cleveland College of Physicians and Surgeons, etc. Illustrated. E. & B. Treat & Co., New York, 1909.

In 1869 Timothy Holmes published a book of about seven hundred pages on the Surgical Treatment of Children's Diseases, the first text-book to deal exclusively with pediatric surgery. Until the date of writing the volume about to be reviewed, no American writer had yet produced a text-book devoted entirely to the surgical affections of children, and, as the author states in his preface, " to adapt such a treatise to present conditions of practice and education must be regarded as a pioneer endeavor."

In the present era of specialization and with the tendency of the past decade to subdivide the field of surgery into its many branches, it must be regarded as rather remarkable that no attempt has heretofore been made to invade a field so full of attractive possibilities and usefulness.

In the average text-book on general surgery, the acute surgical affections of children, as distinguished from those of adults, receive but scanty or passing attention, but in the work of Dr. Kelley the author has endeavored to include and give proper elaboration to all of the affections, both congenital and acquired, which come within the domain of so-called pediatric surgery. To any one who has had opportunity to observe and work in this field, with its many and varied difficulties in the interpretation of signs and symptoms, and the necessary refinement of surgical judgment and technic, no excuse need be offered for the production of such a work.

The author deals with his subject in logical order, there being in all twenty-six chapters, the first two of which are devoted to general subjects, such as examination, case taking, asepsis, lavage, rectal feeding, hemorrhage, and shock. Chapters three, four and five are given to a consideration of the general pathology of the developing period; malformations, tumors, cysts, such constitutional diseases as hæmophilia and the various infections, including tuberculosis, syphilis, septicæmia, erysipelas, tetanus, etc. In the succeeding four chapters considerable space is given to affections of the muscles, tendons, and bursæ, and diseases of the periosteum, bones, and joints. Chapters ten, eleven, and twelve include fractures, dislocations, separation of epiphyses, and diseases of the lymphatic system. Then, in order, the surgery of the various regions of the body is taken up.

The chapter on the head and brain is noteworthy for the article on cranio-cerebral topography and the inclusion of the most modern observations on the operative treatment of hydrocephalus. The section on diseases of the air passages and thorax contains a good chapter on empyema, even though the expressions of opinion on the methods of drainage and the employment of irrigation are somewhat at variance with those of most modern observers. In the section on diseases of the abdomen and its contents, the chapters on appendicitis and intussusception are the most noteworthy. The author's views on appendicitis in children are thoroughly sound and modern. He recognizes that in children a much more serious problem is presented than in adults; namely, that the mortality is higher, that there is a greater liability to pus formation, and a special proneness to such complications as peritonitis and intestinal paresis. Early operation is advised in all cases. The chapters on hernia, diseases of the rectum and anus, and genito-urinary system are well written, and in the two latter much valuable information may be obtained on some of the more frequently met congenital affections such as atresia of the rectum and anus, epispadias, hypospadias, undescended testicle, etc. The work is concluded with a consideration of harelip and cleft palate and a chapter on club-foot which might well have been included in the section on orthopædic surgery.

Some subjects fail to receive the proper amount of space and attention which is due them, among which may be noted branchial cysts which are merely mentioned in passing and which not infrequently come to the pediatric surgeon as one of his most difficult problems, so far as treatment is concerned.

The work is moderately well supplied with illustrations, but it cannot be said that they are uniformly clear, nor do they always present the impression or convey the idea for which an illustration is intended.

WALTER A. SHERWOOD.

PRATIQUE DE LA CHIRURGIE ANTISEPTIQUE. Leçons professées à l'Hotel-Dieu, par le docteur J. LUCAS CHAMPIONNIERE. Octavo, 464 pages, with a portrait of Lord Lister. Paris, G. Steinheil, 1909.

This book is an enlargement of the author's earlier effort, "Manuelle de Chirurgie Antiseptique." It is somewhat startling to encounter at this advanced period in the evolution of the treatment of wounds such an elaborate treatise on true listerian antiseptic surgery, yet, emanating from the pen of so accomplished a surgeon of international repute, it merits careful attention.

According to Championniere, "The antiseptic method is not any application whatever of the principle of the suppression of germs. It is a clinical method, not an invention, to accomplish which it must be applied with persevering fidelity."

Of aseptic surgery he delivers himself thus: "I have studied the new facts advocated in aseptic surgery as I studied listerian surgery. But regarding it closely and availing myself of all the terms of comparison, I have come to the conclusion, well supported, that aseptic surgery is not a new method. It represents only the acquisition of some useful means of sterilization and certain technical applications to some particular cases. Thus aseptic surgery is above all practiced in abdominal work. We are much inclined to attribute to asepsis the marvellous results that the *perfection of technic* has brought to surgery. Every time we experiment in another field of surgery, we encounter difficulties which show that asepsis does not respond to the generality of assembled facts of surgery." At the parting of the ways Championniere prophesies of asepsis: "In its actual generalization it represents only a marked reaction upon the genial conception of Lister, and it is a practice which will be fatally modified as soon as the infatuation shall have been tempered by experience and time."

A last dart is hurled at asepsis, in this fashion: "One of the consequences of aseptic surgery is the neglect of that surgery for which the immense majority of injured consult us."

It should not be construed as being in the last derogatory to our highest esteem of antisepsis, when we designate this eulogium of antisepsis as a bandying of words and which turns out to be an apologia critica rather favorable to asepsis. It is ever with interest that we turn to reminiscences recounting campaigns in behalf of antisepsis, and Championniere gives us in the first pages a charming narrative of early conquests, but he loses greatly when he attempts to discredit the progress due physical methods of sterilization, by stating that, "badly cleaned instruments which harbor albuminous matter in crevices are not to be sterilized by boiling water," whereas a preliminary cleansing, according to Listerian teaching, and steeping in carbolized solution does effect this! To which we reply that this preliminary cleansing of instruments has been retained by the devotees of asepsis from antiseptic school-days. The practice current in France to render instruments sterile, by placing them in a dish of flaming alcohol (alcohol punch), does not appeal to us—and rightly deserves the condemnation gives by Championniere.

In the matter of the employment of sterilized gowns, Championniere says there is no great advantage: "I have always passed over this precaution; the garments in question ought never to come in contact with the wound or field of operation." (?) Such contact is unavoidable—wherefore sterile gowns are imperative.

Thirty-three chapters with many subdivisions, covering 458 pages, are devoted to a most exacting description of all that is orthodox in antisepsis, of these but a few instances have been singled out by way of comparison, to show how essentially the orthodox school of antisepsis, pictured by Championniere, differs from the dissenters whose faith centers in asepsis.

Antisepsis is still a surgical therapeutic measure from whose loin asepsis sprung, hence our heartiest recommendations for the study of this masterful volume, replete in history, reminiscences, evolution and scientific aspects of the discipline in antiseptic surgery. A large number of formulæ and some therapeutic medications which facilitate their application greatly enhance the practical worth of this volume.

MARTIN W. WARE.

APPENDICITIS AND DISEASES OF THE VERMIFORM APPENDIX. By HOWARD A. KELLY, M.D. Philadelphia and London: J. B. Lippincott Company.

Dr. Kelly and Dr. Hurdon published in 1905 "The Vermiform Appendix and Its Diseases," a volume which was, as the author states, a great storehouse of well-digested facts relative to the protean diseases of this little organ.

This second volume of Dr. Kelly's is shorter by 300 pages, and the author has succeeded well in his desire to place before us a compact résumé, dwelling with especial care on the practical side of the subject.

The book commences with a history of the records of diseases of the vermiform appendix. This chapter is full of interest containing, as it does, references to the great surgeons of our own time who have done so much to bring about an accurate knowledge of the morbid conditions of the organ.

Dr. Kelly has always used accurate drawings from specimens to illustrate his text. Throughout the book we find the same plan carried out, and perhaps none of the illustrations are better than those on the anatomy of the appendix.

The short chapter on the physiology starts off with the question, " Has the vermiform appendix any function? " The author quotes several writers who have ascribed certain functions to the appendix, but leaves us in an " attitude of expectant observation " after calling attention to the muscular contractions which take place in the appendix both within and without the body. Next follows a chapter on Bacteriology, and after that four exhaustive and well illustrated chapters on the always interesting question of the Pathology of diseases of the appendix. In the chapter on Etiology there is reference to family predisposition and to instances of coincident attacks in members of the same family, suggesting a general infectious origin. The chapter on Clinical history describes accurately the story put before us so often. In the introductory to this chapter we find a remark which coincides so accurately with our own ideas that we quote it: " The wider the experience of the surgeon in dealing with the protean forms of this disease, the less confidence will he have in formulating any definite conclusions regarding the interpretation of its individual symptoms, and particularly concerning their prognostic value."

The subjects of the leucocytes in appendicitis, typhoid fever and appendicitis, appendicitis in childhood and appendicitis in old age, are all treated in a comprehensive and satisfactory manner.

In the chapter on Typhilitis the author shows: The possibility of an ulceration of the appendix involving the cæcum; the possibility of an ulcer of the appendix and an ulcer of the cæcum existing at the same time; the possibility that an ulceration may exist in the cæcum alone. But he shows also how rare these conditions are. There is reference in this chapter to the affections once known as typhlitis, cæcitis, stercoral typhilitis, and tuphlo-enteritis, all names almost unknown to the medical student of to-day.

Chapter XVI, on the treatment previous to operation, depicts the position held by the majority of conservative surgeons in this country. The author gives nineteen " Aphorisms in appendicitis for the general practitioner," the principles of which, if learned and appreciated by the profession at large, would certainly lessen the mortality of this treacherous disease.

Under the caption of general considerations regarding operation, the author discusses the points which have been the subject of debate so often in the past, and gives the conclusions which most of us in this country at least regard as facts.

Dr. Kelly then describes the operative treatment, giving in detail the various incisions and the different methods of treating the stump.

The chapters on abscess near the appendix and peritonitis are particularly well illustrated and complete.

After discussing the postoperative sequelæ and appendicitis in gynæcology and obstetrics, the author closes with a chapter on Neoplasm and a very important chapter on the medicolegal aspect of appendicitis as caused by trauma.

If the principles laid down in this work of Dr. Kelly's were generally adopted, we would say with Dieulafoy, " No one should die of appendicitis."

W. B. Brinsmade.

Surgical Diseases of the Abdomen. By Richard Douglas, M.D., formerly Professor of Gynæcology and Abdominal Surgery, Vanderbilt University, Nashville. Edited by Richard A. Barr, B.A., M.D., Professor of Abdominal Surgery, Vanderbilt University. Philadelphia: P. Blakiston's Son & Company, 1909.

Since the first edition of this work some six years ago, the advances in the diagnosis of abdominal conditions have not been commensurate with those in the line of operative technic, but are certainly enough to have warranted a revision of, or better an adding to, our former knowledge of some of the conditions.

The general scope of the work is the same and its arrangement practically unchanged. The etiology of the various diseased conditions of the abdominal contents are taken up thoroughly and discussions interspersed where diverse theories have arisen as to the importance which should be accorded a certain factor. Then follows a pathological review of the subject in hand, which leads up to a comprehensive symptomatology. The consideration of the operative procedures both pro and con are accurate, brief and indicative.

Appended to each section is a bibliography referring to the more important monographs which have appeared relative to the condition considered. No attempt has been made by the author to introduce any surgical technic. The volume consists of 878 very readable pages, the subject matter itself being expressed in an interesting but at the same time accurate manner.

To the medical student especially the book will be of great value, since it contains details which the larger surgical text-books so often omit. He will particularly appreciate the accuracy of the various differential diagnoses which are well shown by the use of tabulated parallel columns profusely scattered throughout the book and lend to it a certain facility of reference not found, as a rule, in other similar considerations of the subject.

James T. Pilcher.

A Textbook of Gynæcological Diagnosis. By George Winter, O. O. Professor and Director of the Rgl. Universität Frauenklinik in Königsberg, Prussia, with the Collaboration of Carl Ruge of Berlin. Edited by John G. Clark, M.D., Professor Gynæcology, University of Pennsylvania. After the Third Revised German Edition. Illustrated by four full-page plates and three hundred and forty-six text illustrations in black and colors. Philadelphia and London: J. B. Lippincott Company, 1909.

In the preface of the first edition of this work, written in 1896, Professor Winter calls attention to the tremendous strides which had been made in gynæcological diagnosis and of the great value derived from the comparison of the palpatory findings before operation with the conditions revealed at operation. He believed, at that time, that gynæcological diagnosis had become a science and a study of such importance that it demanded special treatment.

In the preface of the third edition, of which the present volume is a translation, he states that as gynæcological diagnosis had developed greatly both clinically and pathologically during the ten years since the second edition appeared, and, as his own views of the subject had also changed, he had found it necessary to revise the entire work. The greater part of the work was prepared by Professor Winter, while Professor Carl Ruge contributed the part on microscopic diagnosis.

In the preface of the present edition Dr. Clark states that "In order to adapt this translation to American use, brief editorial annotations have been made here and there, which have appeared essential to the wider adaptation of the book to this country. These comments are contained in separate editorial paragraphs, enclosed in brackets, thus leaving the translated German text intact."

The work is divided into three parts, General Diagnosis, Special Diagnosis, and Analytical Diagnosis. Under General Diagnosis the various methods of gynæcological examination are described, and seventy-five pages are devoted to this subject. The next five hundred and twenty-five pages, *i.e.*, the greater part of the work, is devoted to Special Diagnosis. There is an excellent description of the "normal findings" as a foundation for the interpretation of pathological conditions—the topographic anatomy for the palpatory diagnosis and the normal histology for the microscopic diagnosis. This is followed by chapters on the following subjects: Diagnosis of Normal Pregnancy; Diagnosis of the Disturbances of Pregnancy; Microscopic Diagnosis of Pregnancy; Microscopic Diagnosis of the Membranes Expelled from Genitalia, especially from the Uterus; Displacements of the Uterus and Adjacent Organs; Diagnosis of Uterine Myomata; Diagnosis of Ovarian Tumors; Diagnosis of Malignant Diseases of the Uterus; Neoplasms of the Vagina; Neoplasms and Ulcerations of the Vulva; Microscopic Diagnosis of Malignant Diseases of the Uterus, Vagina and Vulva; Microscopic Diagnosis of Polyps and Tissue Fragments from the Genitalia; Diagnosis of Tubal Diseases; Diagnosis of Pelvic Peritonitis; Diagnosis of Parametritis; Diagnosis of Uterine Catarrh; Microscopic Diagnosis of Endometritis; Diagnosis of Malformation of the Internal Genitalia; Diagnosis of Diseases of the Urinary Apparatus.

The plan of the special diagnosis of the various conditions is as follows: the pathological conditions are first described and these are followed by a description of the methods of examination best adapted for the diagnosis of each condition and especially what the palpatory findings should be. Finally the differential diagnosis between it and conditions simulating it are given.

The chapters on microscopic diagnosis are very thorough and well illustrated.

Under Analytical Diagnosis, the Causes of Hemorrhage, Amenorrhœa, Dysmenorrhœa, Sterility, and Abdominal Tumors are given and methods of diagnosis are described.

This work represents the methods of diagnosis employed by one of the foremost German teachers with annotations from one of our own; and as a third edition it also represents a thorough revision of a plan of teaching gynæcological diagnosis used by the writer for several years. That plan is the description of the various pathological conditions present and then the demonstration of how a diagnosis should be made, with especial emphasis on the palpatory findings present.

The book making, including the index, is of the best, and the illustrations, while not uniformly excellent, clearly show what they are intended to represent. The diagrammatic illustrations are particularly instructive. To Dr. R. Max Goepp thanks are due for presenting us with a most excellent translation.

This book may be recommended not only to the student and general practitioner but especially to the gynæcologist as it contains many points in the finer diagnosis of gynæcological conditions which should be greatly appreciated by him.

JOHN A. SAMPSON.

MYOMATA OF THE UTERUS. By HOWARD A. KELLY, M.D., Professor of Gynæcologic Surgery at Johns Hopkins University, and THOMAS S. CULLEN, M.D., Associate in Gynæcology at Johns Hopkins University. W. B. Saunders Company, 1909.

Kelly and Cullen have produced in this volume a monograph that is an authority and will remain as such for some time. It deals thoroughly with the subject in question in all its stages and modifications. They have made a wise decision in not trying to review, in the book, the great collection of literature to be found on the subject, but to confine themselves to their own personal work, as the medical profession well know how valuable are contributions from the personal pens of these two well-known men on their particular subjects, and, for this reason, would naturally attach more value to such a publication. Their methods of study of cases show the great advantage of the card index system.

There is the usual wealth of original illustrations which we have come to expect of these authors. They have laid particular stress on the sarcomatous changes that are liable to occur in myomata and its association with carcinoma of the fundus uteri, and the importance of early operative measures are dwelt upon at length. No longer may we hope to achieve the best results by awaiting for the disappearance of the tumor after the menopause. They have shown well the tendency at times of the tumor to become detached from the uterus and the resulting parasitic nature of the detached portion. Particular stress is laid upon the method of ligating vessels supplying the tumor (especially when they come from neighboring organs) by the method of double ligation during operative work upon such growths. Their failures as well as successes are brought out so that the reader may have a true knowledge of their vast experience and wealth of material. This is something the whole profession should appreciate. Mistakes and failures should form a larger proportion of our medical literature. Many of us are afraid of criticism when, as a matter of fact, it is thus we learn. The oft-supposed cardiac complications of myomata are shown in most cases to be functional murmurs. The difficulty of diagnosis in certain cases is well brought out. Although a large proportion of their cases have occurred in colored women, no importance is laid upon this in the discussion of causative factors. It would have been interesting could we have had greater extracts from the histories of the cases, particularly regarding the early menstrual history.

It was first brought to the attention of the reviewer by Dr. George MacNaughton of Brooklyn, that as a causative factor a great many cases give a distinct history of an early dysmenorrhœa of the character of that associated with anteflexion of the cervix, and special stress was laid upon the possible circulatory interference of such deformity. If this is a fact, we should insist upon an early examination in young girls suffering from a persistent dysmenorrhœa, and institute such treatment as may be deemed proper for the cure of the existing condition, thereby preventing the future development of myomata.

That the dilatation of the lymphatics spoken of is also found associated with many other pelvic conditions and often exists as a separate entity and has a symptomatology of its own, is the experience of the reviewer. When we remove a pregnant myomatous uterus, we all feel chagrined. We feel glad that the authors have cited such instances in their own experience.

The period of convalescence in their work is rather longer than that of New York surgeons. The favoring of calcareous deposits following the electrical treatment of these conditions as brought out in the text, is an interesting point for those of our brethren who use this method. Operative methods are well described and illustrated, giving due credit to Noble. The large abdominal incision and supravaginal hysterectomy are favored in most cases and their advantages well shown. It seems well that the authors advise the abandonment of vaginal hysterectomy for the myomatous uterus which has also become the victim of carcinoma when it is possible to do the abdominal operation. The vermicular action of the uterus spoken of on manipulation is an invaluable point for operators and one not generally known. Postoperative complications, especially fever and rapid pulse rate, are shown to be common, more so than any other previous author has shown or admitted. Appropriate space is allowed myomata complicating pregnancy and its method of treatment.

The authors have given to those doing operating gynæcology a valuable book of reference and one which should be on the shelves of both the specialist and the general practitioner. To the reviewer his work has been of pleasure and of great profit.

ALBERT W. JUDD.

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